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M3 EtherCAT
AC Servo System
Hardware Manual

SHANGHAI AMP&MOONS' AUTOMATION CO.,LTD.

目录

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1 Introduction

1.1 About this manual

This manual describes the M3 Servo Drive.

It provides the information required for installation, configuration and basic operation of the M3 series AC servo drive.

This document is intended for persons who are qualified to transport, assembling, commission, and maintain the equipment described herein.

1.2 Documentation Set for M3 EtherCAT series AC servo

This manual is part of a documentation set. The entire set consists of the following:

● M3 EtherCAT Hardware Manual. This includes hardware installation, configuration and operation.
● M3 EtherCAT User manual. This introduces drive configuration, debugging and exception handling.
● M3 EtherCAT Communication User Manual. This introduces thedrive EtherCAT protocol functions.
● Luna Software user manual.

1.3 Safety

Only qualified persons may perform the installation procedures. The following explanations are for things that must be observed in order to prevent harm to people and damage to property.

The M3 utilizes hazardous voltages. Be sure the drive is properly grounded.

Before you install the M3, review the safety instructions in this manual.
Failure to follow the safety instructions may result in personal injury or equipment damage.

1.4 Safety Symbols

Safety symbols indicate a potential for personal injury or equipment damage if the recommended precautions and safe operating practices are not followed.

The following safety-alert symbols are used on the drive and in the documentation:

⚠ Caution   ⚡ Warning - Dangerous voltage

⏚ Protective earth   ♨ Caution - Hot surface

1.5 Safety Instructions

1.5.1 Installation

⚠	DO NOT subject the product to water, corrosive or flammable gases, and combustibles.
	DO NOT use the motor in a place subject to excessive vibration or shock.
	Never connect the motor directly to the AC power supply.
	DO NOT use cables soaked in water or oil.
	DO NOT extrude or pull-off the cable, nor damage the cables as electrical shocks, damages may result
	DO NOT block the heat dissipating holes. Please prevent any metal filings drop into the drive when mounting.
	DO NOT touch the rotating shaft when the motor is running.
	DO NOT strike the motor when mounting as the motor shaft or encoder may be damaged.
	DO NOT Touch either the drive heat sink or the motor and regenerative resister during operation as they may become hot.
	DO NOT hold the motor cable during the transportation or mounting.

1.5.2 Wiring

⚠	DO NOT connect any power supplies to the U,V,W terminals.
	Please connect the output UVW of the driver and the UVW of the servo motor directly without passing through an electromagnetic contactor.
	Please tighten the fixing screws of the power supply and motor output terminals, otherwise it may cause a fire.
	Please do not switch the main power supply of the drive frequently. If you really need to switch the power supply repeatedly, please control it once a minute.
	Install the encoder cable in a separate conduit from the motor power cable to avoid signal noise.
	Use multi-stranded twisted-pair wires or multi-core shielded-pair wires for signal, encoder cables.
	As a charge may still remain in the drive with hazardous voltage even after power has been removed, Do not touch the terminals when the charge LED is still light.
	Please observe the specified voltage.
	When wiring, please remove the terminal block from the servo drive.
	One wire insertion port of the terminal block, please insert only one wire.
	When inserting the wire, please do not short-circuit the core wire with the adjacent wire.
	Make sure both the drive and the motor grounded well.
	Please ensure grounding wires are securely connected when power up.

1.5.3 Pilot Run

⚠	DO NOT touch the rotating shaft when the motor is running.
	In order to prevent accidents, the initial trial run for servo motor should be conducted under no load conditions (separate the motor from its couplings and belts).
	Incorrect parameters will cause abnormal operation under load.
	The temperature of the drive radiator, motor, and external regenerative resistor will rise during operation, please avoid touching.
	Before the machine starts to run, please confirm whether the emergency stop device can be activated at any time.
	Use servo motors with brakes on vertical loads to prevent equipment from falling when alarms, failures, or power failures occur.

1.6 Standards Compliance

		Drive	Motor
Europe	EMC Command	EN 61800-3	EN 55011
			EN 55014-1
			EN 55014-2
			EN 6100-3-2
			EN 6100-3-3
	LVD	EN 61800-5-1	EN 60034-1
			EN 60034-5
	STO	UL61800-5-2(SIL2)	
		IEC61508	
		ISO13849-1(PL d)	
UL		UL 61800-5-1	UL 1004-1
			UL 1004-6
CSA		C22.2 No.274-13	CSA C22.2 No.100

1.7 Maintenance and Inspection

1.7.1 Check items and cycle

The normal use conditions of the servo are as follows:
Annual average environmental temperature: 30℃
Average load rate: below 80%
Daily running time: less than 20 hours

Type	Cycle	Check Items
Daily inspection	Daily	◆ Confirm the ambient temperature, humidity, dust, foreign matter, and dew condensation
		◆ Whether there is abnormal vibration or noise
		◆ Power supply voltage
		◆ Odor
		◆ Whether the fan is working normally and whether there is any foreign matter in the vent
		◆ Whether the connector is loose
		◆ Whether there is foreign matter between the cable and the connector, and whether the cable conductor is exposed outside
		◆ Whether the fastening part is loose

1.7.2 Replacement of parts

The internal components of the servo product will wear out or aging, and the replacement time of components will vary according to environmental conditions and usage methods. If you need to replace it, please contact our company or our agent. Except for our company, please do not disassemble and repair by yourself.

Item	Part	Standard replacement cycle	Notice
Drive	Filter capacitor	About 6 years	The standard replacement cycle is for reference only. Even if the standard replacement cycle is not full, it needs to be replaced once an abnormality occurs.
	Aluminum electrolytic capacitors	About 6 years	
	Power-on buffer relay	About 100,000 times(According to the conditions of use)	
	Power-on buffer resistance	About 20,000 times(According to the conditions of use)	
	Fan	2~3 years (10,000~30,000 hours)	
Motor	Oil seal	5,000 hours	
	Battery of encoder	According to the conditions of use	

2 Product Introduction

2.1 Unpacking Check

Please refer to the following chapters to confirm the model of servo drive motor.

A complete and operable servo system should include the following parts:

● Servo drive and servo motor with matching power

● Motor power cable for connecting the drive and servo motor (optional)

● Encoder cable used to connect the drive and servo motor (optional)

● Mini USB communication cable for CN1 port to PC (optional)

● I/O connector for CN2 port (Included)

● Encoder connector for CN3 port (optional)

● The second encoder connector for CN4 port (applicable to the drive with full closed loop function, optional)

● STO connector for CN5 port (applicable to drive with STO function, Included)

● RJ-45 connectors for IN (CN7) and OUT (CN6) ports for EtherCAT communication (optional)

● Driver power input connector for P1 port

● Motor power and regeneration resistor connector for P2 port

2.2 Servo Drive Model Introduction

2.2.1 Drive Name Plate Description

2.2.2 Drive Model Description

M3DV - 2 3A0 P F - ***
①   ② ③ ④ ⑤ ⑥

① M3 Series
② Input Voltage *1

   2 -----Single/Three-Phases 220VAC
④ Control Mode Type
⑤ Function Type
⑥ Version Number

*1 Line to Line Voltage
*2 Available for both single-phase or three-phase power connection.
*3 Available for single-phase while the motor power is under 1.8kW.

③ Current

	Rated Current A(rms)	Peak Current A(rms)	Power
*2 1A8	1.8	5.4	100/200W
*2 3A0	3	12	400W
*2 4A5	4.5	15	750W
6A0	6	21	1.0kW
*3 10A	10	30	1.5kW
13A	13	45	2.0kW
18A	18	58	3.0kW

		High-density Soldering I/O Connector (50pin)		PUSH-IN Spring Type I/O Connector (26pin)	
⑤ Function Type		F	R	X	N
④ Control Mode		EC			
Control Mode	Position Mode	√	√	√	√
	Velocity Mode	√	√	√	√
	Torque Mode	√	√	√	√
	Q Program	√	√	√	√
	Full closed loop	√		√	
IO	2 analog inputs	√		√	
	1 analog outputs	√		√	
	8 inputs/4 outputs(Digital)	√	√	√	√
	Encoder output	√			
	Second encoder input	√		√	
Communication	USB(Software configuration)	√	√	√	√
	EtherCAT	√	√	√	√
Safety Function	Dynamic brake	√		√	
	STO	√		√	

2.2.3 Drive specification

1)Electrical specifications

■ Single-phase/Three-phase 220VAC servo drive

Drive P/N	M3DV-21A8EC◆	M3DV-23A0EC◆	M3DV-24A5EC◆
Mian Circuit	Single-phase/Three-phase AC200 ~ 240V±10%，50/60Hz		
Control Circuit	Single-phase AC200 ~ 240V±10%，50/60Hz		
Continuous Output Current A(rms)	1.8	3	4.5
Maximum Output Current A(rms)	5.4	9	13.5
Insulation Voltage	Primary side to ground: withstand voltage 1500VAC, 1 min, (leakage: 20mA) 【220V Input】		

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■ Three-phase 220VAC servo drive

Drive P/N	M3DV-210AEC◆	M3DV-213AEC◆
Main Circuit	Three-phase AC200 ~ 240V±10%，50/60Hz	
Control Circuit	Single-phase AC200 ~ 240V±10%，50/60Hz	
Continuous Output Current A(rms)	10	13
Maximum Output Current A(rms)	33	40
Insulation Voltage	Primary side to ground: withstand voltage 1500VAC, 1 min, (leakage: 20mA) 【220V Input】	

◆Represents the Function type

2) Common specifications

Environment	Temperature		◆ Ambient temperature:0°C to 50°C(If the ambient temperature of servo drive is greater than 45°C, please install the drive in a well-ventilated location) ◆ Storage temperature: -20°C to 65°C
	Humidity		Both operating and storage : 10 to 85%RH or less. No condensation
	Altitude		Lower than 1000m
	Vibration		$9.8m/s^2$ or less, 10Hz to 60Hz(No continuous use at resonance frequency)
Control Method			IGBT：PWM Sinusoidal wave drive
Encoder Feedback			◆ 20-bit Incremental/Absolute encoder ◆ 17-bit Magnetic incremental encoder ◆ 17-bit Battery-less absolute encoder
Second Encoder Input	A/B phase		A/B differential signal input
I/O	Digital Signal	Input	8 Configurable Optically isolate digital general inputs, 5-24VDC, max input current 20mA
		Output	4 Configurable optically isolated digital outputs, 30VDC, max output current 30mA
	Analog Signal[*1]	Input	2 analog inputs, -10V ~ +10V, 12Bits A/D
		Output	1 analog outputs, -10V ~ +10V, Max 10mA
Communication	USB		Connect with PC
	EtherCAT		EtherCAT communication
Operation Panel			◆ 4 keys(MODE, UP, DOWN, SET) ◆ 5-digit LED
Regeneration Resistor			Built-in regenerative resistor
EtherCAT LED			EtherCAT IN/OUT connect display, RUN and ERROR display
Control Mode			CoE(CiA 402), PP, PV, TQ, CSP, CSV, CST,HM and Q program
Control Input Signal			Alarm clear input, CW/CCW Limit, Homing switch, gain switch, zero speed clamp, emergency stop, CW/CCW torque limit, speed limit, general input
Control Output Signal			Fault output (error), warning output (alarm), Servo-Ready, brake release output, speed reached, torque reached, position reached, Servo-ON status output, dynamic error follow output, zero speed signal, speed consistent, torque consistent, speed limit, torque limit, software limit (forward rotation, reverse rotation), general output
Protection			Over current, over voltage, under voltage, over temperature, encoder feedback error, current foldback, excessive speed, position error, emergency stop, forward/reverse limit, full closed-loop control position error, communication error, Loss phase of main power supply
Dynamic Brake[*2]			-F/X type only
STO[*2]			-F/X type only

Note：*1、*2 Some models are not supported, please refer to the drive model description on page 10 for details

2.2.4 EtherCAT Communication Specification

Communication Standard	IEC 61158 Type12，IEC 61800-7 CiA402 Drive Profile
Physical Layer	100Base - Tx
Comm Port	RJ45 x 2 (IN and OUT)
Communication Rate	2 x 100 Mbps (Full duplex)
Communication Cable	Shielded twisted pair CAT5e (straight-through/cross-over)
Transmission distance	100m(between adjacent nodes)/Daisy-Chai
Sync Manager	SM0: Output mailbox SM1: Enter mailbox SM2: Output process data SM3: Input process data
FMMU	FMMU0: Mapped to process data (RxPDO) receiving area FMMU1: mapped to process data (TxPDO) transmission area FMMU2: Map to mailbox status
Application Layer Protocol	CoE：CANopen over EtherCAT VoE：Vendor access over EtherCAT *
Synchronization Modes	Free Run SM Event DC SYNC Event
Message Types	SDO: SDO is used for acyclic data transmission PDO: PDO is used for cyclic date transmission EMCY: EMCY is used for error report when a fault has occurred in the drive.
LED Status	EtherCAT RUN x 1 EtherCAT ERR x 1 EtherCAT Link/Activity x 2
Control Mode	Profile Position Mode(PP) Profile Velocity Mode(PV) Profile Torque Mode(TQ) Homing Mode(HM) Cycle Synchronized Postion Mode(CSP) Cycle Synchronized Velocity Mode(CSV) Cycle Synchronized Torque Mode(CST)

*: Support to upgrade firmware via EtherCAT

2.2.5 Regeneration resistor specification

When the output torque of the motor shaft is opposite to the direction of rotation, the energy is fed back from the motor load end to the drive bus capacitor, which makes the bus voltage increase. When it reaches the braking voltage point, the energy can only be consumed by the regeneration resistor, otherwise it will damage the servo drive. The regeneration resistor can be built-in or the user can be connected externally; the built-in and external regeneration resistors cannot be used simultaneously. The related specifications of the built-in regeneration resistor in the M3 EtherCAT series servo drive are as follows:

Drive P/N	Built-in resistor		External resistor
	ohm (Ω)	Power (W)	Minimal value (Ω)
M3DV-21A8EC◆	200	40	40
M3DV-23A0EC◆	200	40	40
M3DV-24A5EC◆	100	60	40
M3DV-26A0EC◆	25	80	15
M3DV-210AEC◆	25	80	15
M3DV-213AEC◆	25	80	15

◆ `Represents the Function type

2.2.6 Drive Dimensions(Unit:mm)

■ M3DV-21A8EC◆（50W、100W、200W Type）
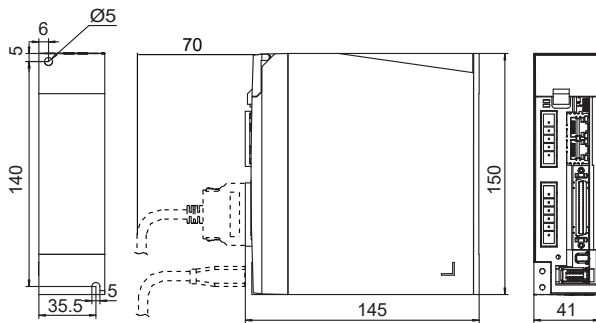
■ M3DV-23A0EC◆（400W Type）
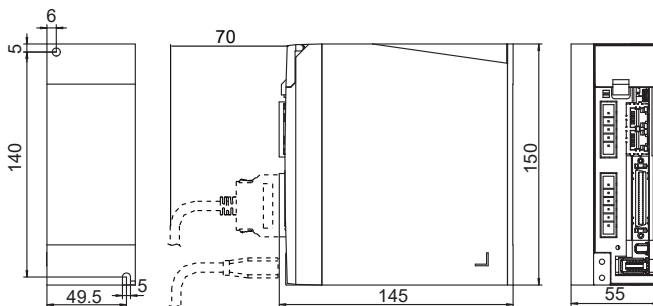
■ M3DV-24A5EC◆（750W Type）
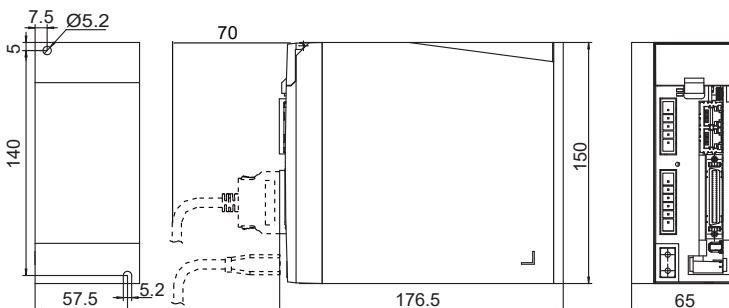
■ M3DV-26A0EC◆（1000W Type）
■ M3DV-210AEC◆（1500W Type）
■ M3DV-213AEC◆（2000W Type）
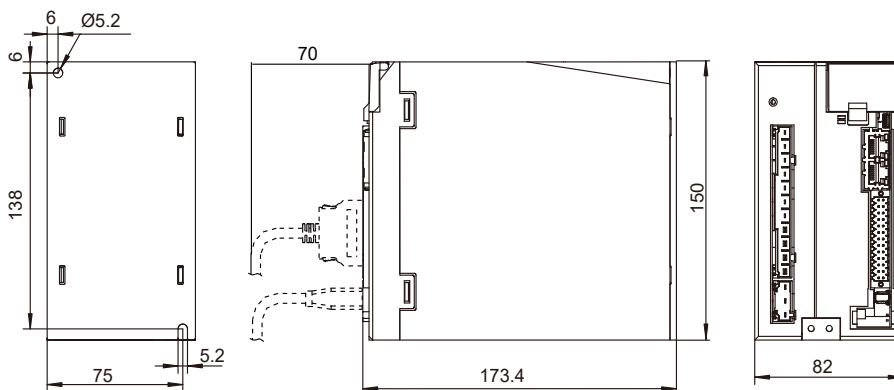
◆ Represents the Function type

2.3 Servo Motor Model Introduction

2.3.1 Motor Name Plate Description

Product Type ——————— | AC SERVO MOTOR
Input Voltage ——————— | Model No:SM3L-062AANDV
| Input:3ΦAC 208~240V 1.5A
| DC Source 320V
Rated Power ——————— | Rated Output:200W
Rated Torque ——————— | Rated Torque:0.64Nm
Rated Speed ——————— | Rated Speed:3000rpm
Max Speed ——————— | Max Speed:6000rpm
Protection Level ——————— | Ins.Class:B IP65 Ambient:40℃
Design ——————— | Designed by AMP&MOONS'
Place of Origin ——————— | Made in China
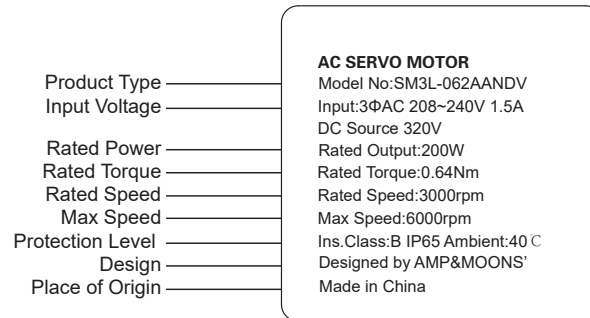
2.3.2 Motor Model Description

SM3 L - 13 1 A A N D V

Servo Motor	
SM3 Series	

Inertia Type	
L	Low Inertia
M	Medium Inertia
H	High Inertia

Frame Size	
04	40mm
06	60mm
08	80mm
10	100mm
13	130mm

Motor Length	
1	1 Stacks
2	2 Stacks
3	3 Stacks
4	4 Stacks
5	5 Stacks

Voltage	
A	220VAC

Shaft	
N	Standard Keyway without oil seal
V	Standard keyway, oil seal shipped with motor, but not installed
K	Standard keyway with installed oil

Connector Type	
D	Direct-mount with sealed plastic connector
M	Direct-mount with sealed metal straight connector

Brake	
N	No brake
B	With brake (24VDC)

Encoder Type	
A	20-bit Absolute Multi-turn Optical Encoder
B	17-bit Battery-less Absolute Multi-turn Encoder
1	20-bit Incremental Optical Encoder
3	17-bit Incremental Magnetic Encoder

2.3.3 Motor Specification and Dimension - Low Inertia Motor

■ 40mm Specification (Low Inertia)

P/N		SM3L - 042A◇□DV
Rated Output Power	watts	100
Rated Speed	rpm	3000
Max Speed	rpm	6000
Rated Torque	Nm	0.32
Peak Torque	Nm	1.28
Rated Current	A (rms)	1.2
Peak Current	A (rms)	5.9
Voltage Constant ± 5%	V (rms) / K rpm	16.8
Torque Constant ± 5%	Nm / A (rms)	0.267
Rotor Inertia	Kg·m^2	0.038×10^{-4}
Rotor Inertia - With Brake	Kg·m^2	0.0433×10^{-4}
Shaft Load - Axial	N (max.)	50
Shaft Load - Radial (End of Shaft)	N (max.)	60
Weight	kg	0.55
Weight - With Brake	kg	0.8

□Represents the encoder type

■ Dimensions (Unit: mm)

1)Without Brake
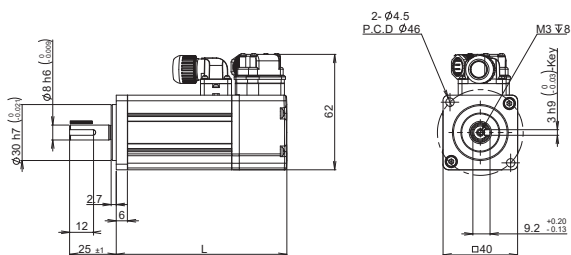
Without Brake	L
SM3L-042A□NDV	91.5
SM3L-042ABNDV	100

2)With Brake
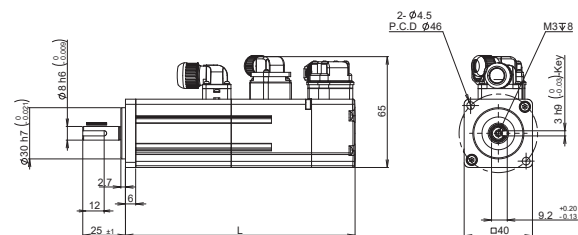
With Brake	L
SM3L-042A□BDV	134.5
SM3L-042ABBDV	143

■ Torque Curves

SM3L-042 (100Watts)
DC Bus: 320VDC (230VAC) - 1.2 Amps
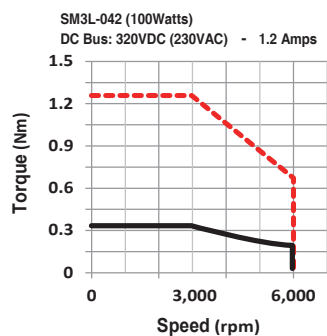
— Max. Continuous Torque
----- Max. Intermittent Torque

■ 60mm Specification (Low Inertia)

P/N		SM3L-061A□◇DV	SM3L-062A□◇DV
Rated Output Power	watts	200	400
Rated Speed	rpm	3000	3000
Max Speed	rpm	6000	6000
Rated Torque	Nm	0.64	1.27
Peak Torque	Nm	1.9	3.8
Rated Current	A (rms)	1.5	2.8
Peak Current	A (rms)	5.4	10
Voltage Constant ± 5%	V (rms) / K rpm	26.5	28.3
Torque Constant ± 5%	Nm / A (rms)	0.427	0.454
Rotor Inertia	Kg·m^2	0.152×10^{-4}	0.237×10^{-4}
Rotor Inertia with brake	Kg·m^2	0.182×10^{-4}	0.268×10^{-4}
Shaft Load - Axial	N (max.)	70	70
Shaft Load - Radial(End of shaft)	N (max.)	200	240
Weight	kg	1.1	1.4
Weight with brake	kg	1.5	1.9

□Represents the encoder type, ◇Represents with or without brake

■ Dimension (Unit: mm)
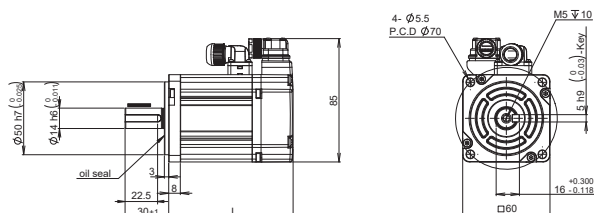
1)Without Brake

Without Brake	L
SM3L-061A□NDV	85.5
SM3L-062A□NDV	104

2)With Brake
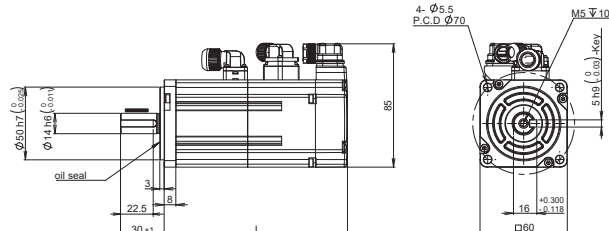
With Brake	L
SM3L-061A□BDV	126
SM3L-062A□BDV	144.5

■ Torque Curves

SM3L-061 (200Watts)
DC Bus: 320VDC (230VAC) - 1.5 Amps

SM3L-062 (400Watts)
DC Bus: 320VDC (230VAC) - 2.8 Amps

— Max. Continuous Torque
---- Max. Intermittent Torque
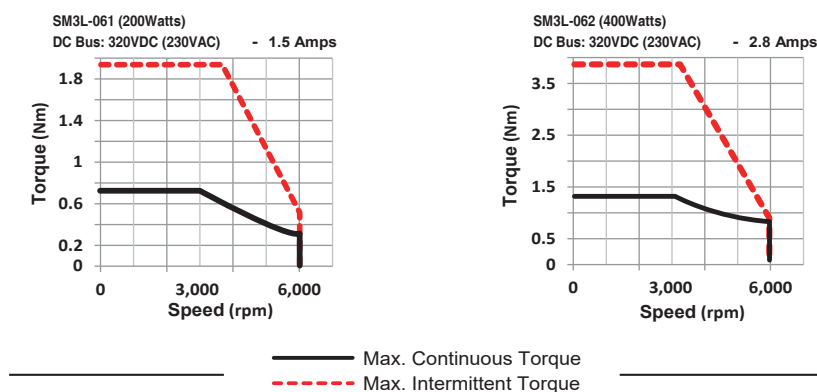
■ 80mm Specification (Low Inertia)

P/N		SM3L-083A□NDV	SM3L-084A□BDV
Rated Output Power	watts	750	1000
Rated Speed	rpm	3000	3000
Max Speed	rpm	6000	6000
Rated Torque	Nm	2.4	3.2
Peak Torque	Nm	6.7	9.6
Rated Current	A (rms)	4.5	5.6
Peak Current	A (rms)	14	19
Voltage Constant ± 5%	V (rms) / K rpm	33.9	36.65
Torque Constant ± 5%	Nm / A (rms)	0.533	0.63
Rotor Inertia	Kg·m^2	0.829×10^{-4}	1.01×10^{-4}
Rotor Inertia - With Brake	Kg·m^2	0.961×10^{-4}	1.12×10^{-4}
Shaft Load - Axial	N (max.)	90	90
Shaft Load - Radial (End of Shaft)	N (max.)	270	270
Weight	kg	2.6	2.8
Weight - With Brake	kg	3.4	3.6

□Represents the encoder type

■ Dimension (Unit: mm)

1)Without Brake
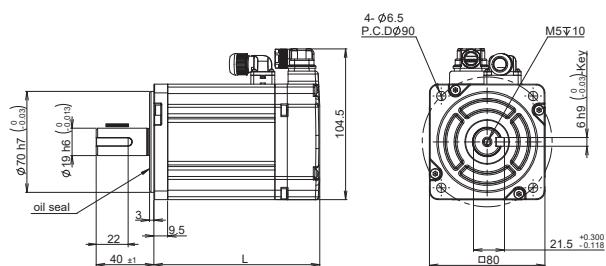
2)With Brake

Without Brake	L
SM3L-083A□NDV	115
SM3L-084A□NDV	129
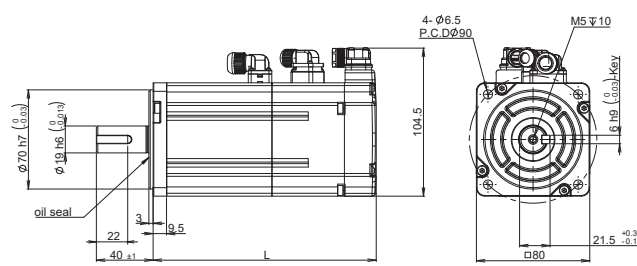
With Brake	L
SM3L-083A□BDV	157.5
SM3L-084A□BDV	171.5

■ Torque Curves

SM3L-083 (750Watts)
DC Bus: 320VDC (230VAC)   - 4.5 Amps
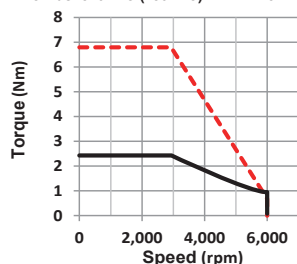
SM3L-084 (1000Watts)
DC Bus: 320VDC (230VAC)   - 5.6 Amps
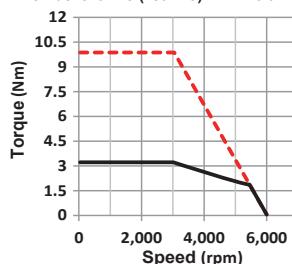
——— Max. Continuous Torque
- - - - Max. Intermittent Torque

2.3.4 Motor Specification And Dimension - Medium Inertia Motor

■ 60mm Specification (Medium Inertia)

P/N		SM3M-062A☐NDV	SM3M-062A☐BDV
Rated Output Power	watts	400	400
Rated Speed	rpm	3000	3000
Max Speed	rpm	6000	6000
Rated Torque	Nm	1.27	1.27
Peak Torque	Nm	3.8	3.8
Rated Current	A (rms)	2.8	2.8
Peak Current	A (rms)	10	10
Voltage Constant ±5%	V (rms) / K rpm	28.9	28.9
Torque Constant ±5%	Nm / A (rms)	0.454	0.454
Rotor Inertia	Kg·m^2	0.639×10^{-4}	0.67×10^{-4}
Shaft Load - Axial	N (max.)	70	70
Shaft Load - Radial(End of shaft)	N (max.)	240	240
Weight	kg	1.6	2.1

☐Represents the encoder type

■ Dimension (Unit: mm)

1)Without Brake
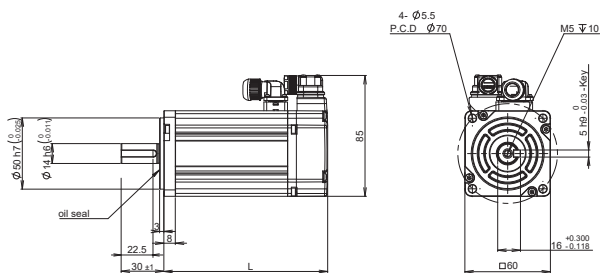
2)With Brake

Without Brake	L
SM3M-062A☐NDV	115
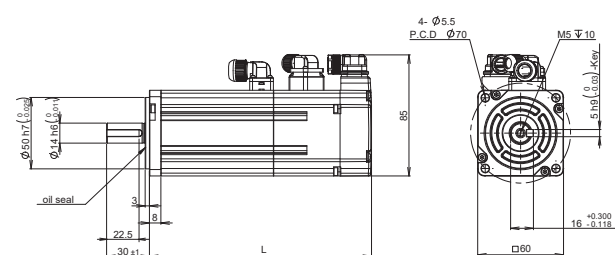
With Brake	L
SM3M-062A☐BDV	155.5

■ Torque Curves

■ 80mm Specification (Medium Inertia)

SM3M-062 (400Watts)
DC Bus: 320VDC (230VAC) - 2.8 Amps

—— Max. Continuous Torque
---- Max. Intermittent Torque
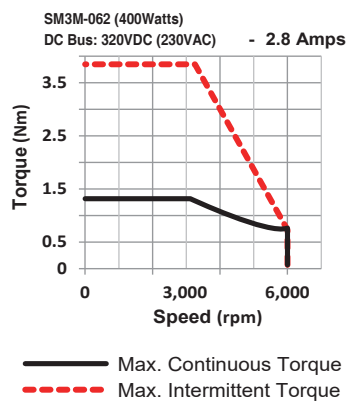
P/N		SM3M-083A☐NDV	SM3M-083A☐BDV
Rated Output Power	watts	750	750
Rated Speed	rpm	3000	3000
Max Speed	rpm	6000	6000
Rated Torque	Nm	2.4	2.4
Peak Torque	Nm	6.7	6.7
Rated Current	A (rms)	4.5	4.5
Peak Current	A (rms)	14	14
Voltage Constant ±5%	V (rms) / K rpm	33.9	33.9
Torque Constant ±5%	Nm / A (rms)	0.533	0.533
Rotor Inertia	Kg·m^2	1.32×10^{-4}	1.45×10^{-4}
Shaft Load - Axial	N (max.)	90	90
Shaft Load - Radial(End of shaft)	N (max.)	270	270
Weight	kg	2.8	3.6

☐Represents the encoder type

■ Dimension (Unit: mm)

1)Without Brake
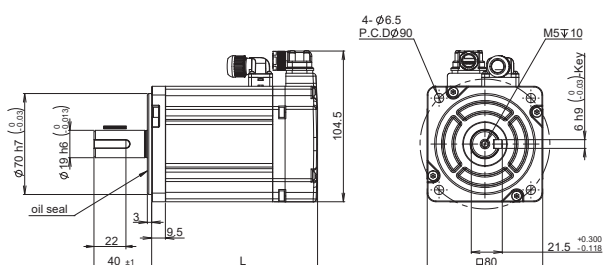
2)With Brake

Without Brake	L
SM3M-083A☐NDV	125.5
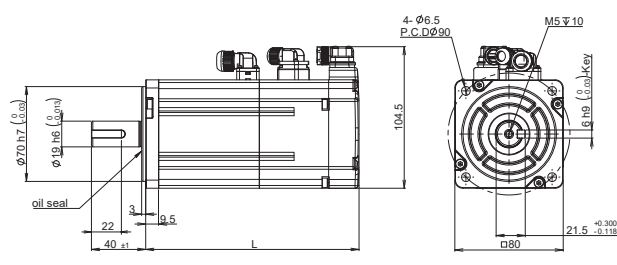
With Brake	L
SM3M-083A☐BDV	168.5

■ Torque Curves

SM3M-083 (750Watts)
DC Bus: 320VDC (230VAC) - 4.5 Amps
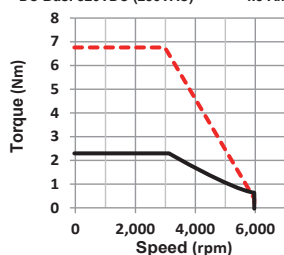
——— Max. Continuous Torque
- - - - Max. Intermittent Torque

■ 130mm Specification (Medium Inertia)

P/N		SM3M-132A□NMV	SM3M-133A□NMV	SM3M-134A□NMV
Rated Output Power	watts	1000	1500	2000
Rated Speed	rpm	2000	2000	2000
Max Speed	rpm	3000	3000	3000
Rated Torque	Nm	4.77	7.16	9.55
Peak Torque	Nm	14.3	21.5	28.6
Rated Current	A (rms)	5.6	8.5	11
Peak Current	A (rms)	16.9	25.2	32.7
Voltage Constant ± 5%	V (rms) / K rpm	54	54.2	55.5
Torque Constant ± 5%	Nm / A (rms)	0.891	0.894	0.916
Rotor Inertia	Kg·m²	13.9×10^{-4}	19.4×10^{-4}	23.3×10^{-4}
Rotor Inertia - With Brake	Kg·m²	16.1×10^{-4}	21.6×10^{-4}	25.5×10^{-4}
Shaft Load - Axial	N (max.)	245	245	245
Shaft Load - Radial (End of Shaft)	N (max.)	680	680	680
Weight	kg	6.9	8	9.6
Weight - With Brake	kg	9.2	10.3	11.9

□Represents the encoder type

■ Dimension (Unit: mm)
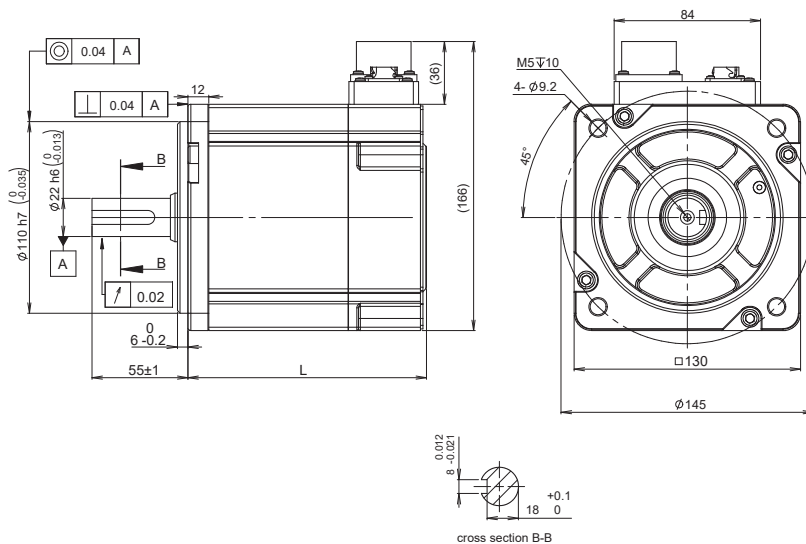
Mode		L
Without Brake	SM3M-132A◇NMV	137
	SM3M-133A◇NMV	151
	SM3M-134A◇NMV	168
With Brake	SM3M-132A◇BMV	170
	SM3M-133A◇BMV	184
	SM3M-134A◇BMV	201

cross section B-B

■ Torque Curves

SM3M-132 (1000Watts)
DC Bus: 320VDC (230VAC) - 5.6 Amps

SM3M-133 (1500Watts)
DC Bus: 320VDC (230VAC) - 8.5 Amps

SM3M-134 (2000Watts)
DC Bus: 320VDC (230VAC) - 11 Amps
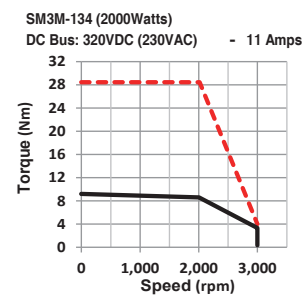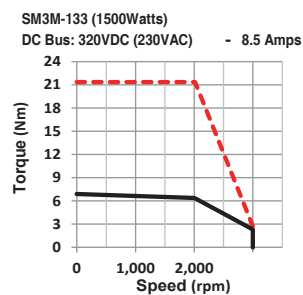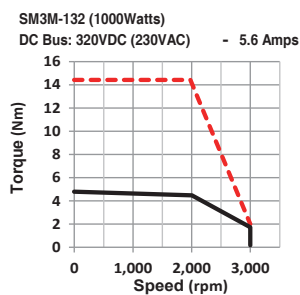
—— Max. Continuous Torque
- - - Max. Intermittent Torque

2.3.5 Motor General Specifications

Encoder Type	17-bit、20-bit, Incremental/Absolute encoder
Insulation class	Class B (130℃)
Protection level	IP65
Installation conditions	Indoor installation, avoid direct sunlight, corrosive and flammable gases
Ambient temperature	Operation：0℃～40℃；Storage：-20℃～60℃
Humidity	Storage and use：20～85%RH (No condensation)
Altitude	1000m or lower
Vibration	Less than 49m/s2，10～60Hz (Can not be used continuously at the resonance point)

2.3.6 Motor Encoder Specifications

Item	Description			
Motor P/N	SM3*-****A***	SM3*-****1***	SM3*-****B***	SM3*-****3***
Vcc of encoder	DC 4.5V～5.5V (Typ 5V)			
Battery voltage	DC 3.3～5.5V (Typ 3.6V)	——		
Current consumption of Vcc	Typ 160mA			
Current consumption of Battery	Typ 15μA	——		
Number of pulses per revolution	1048576 (20-bit)		131072 (17-bit)	
Number of multi-turn gyroscopes	65536 (16-bit)	——	65536 (16-bit)	——
Communication	Half-duplex acyclic serial communication			
Baud rate	4Mbps			
Operation temperature	0～85℃			

2.3.7 Motor Brake Specification

The motor brake is used to prevent the motor from rotating when the brake is power off. The most common way to use it is when the motor is used to control the vertical axis. The mechanism is displaced due to gravity and other reasons, and a servo motor with a brake is required.

When the brake is energized, the armature is absorbed and the brake plate is released, and the motor can operate normally; when the brake is powered off, the armature will be released. The brake plate is locked, and the motor cannot rotate normally.

Motor Frame Size	40mm	60mm	80mm
Static friction torque N	0.32	1.5	3.2
Input Voltage	24		
Power W(20℃)	6.3	7.2	9.6
Current A	0.26	0.3	0.4
Reaction time	Standard air gap，below 20℃<70ms		
Release time	<25ms		
Release voltage	18.5VDC max.(at 20℃)		
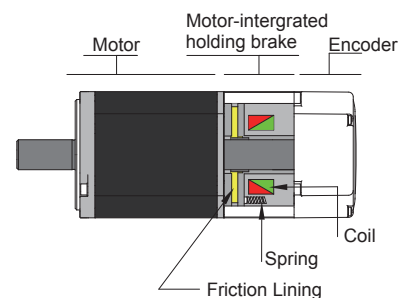
2.4 Servo Drive and Servo Motor Combinations

Servo Drive			
50pin Soldering type I/O Connector			
EtherCAT	M3DV-21A8ECF	M3DV-23A0ECF	M3DV-24A5ECF
	M3DV-21A8ECR	M3DV-23A0ECR	M3DV-24A5ECR
26pin Plug-in type I/O Connector			
EtherCAT	M3DV-21A8ECX	M3DV-23A0ECX	M3DV-24A5ECX
	M3DV-21A8ECN	M3DV-23A0ECN	M3DV-24A5ECN

Servo Motor				
Motor Frame Size & Power				
		40mm, 100W	-	-
		60mm, 200W	60mm, 400W	-
		-	-	80mm, 750W
Low Inertia	Without Brake	SM3L-042A□NDV SM3L-061A□NDV	SM3L-062A□NDV	SM3L-083A□NDV
	With Brake	SM3L-042A□BDV SM3L-061A□BDV	SM3L-062A□BDV	SM3L-083A□BDV
Medium Inertia	Without Brake	-	SM3M-062A□NDV	SM3M-083A□NDV
	With Brake	-	SM3M-062A□BDV	SM3M-083A□BDV

□ Represents the encoder type

2.5 Matching Cable and Connector Accessories

2.5.1 Servo Motor Cable

Motor P/N 1*	Cable Type	Normal Type	Flexible Type 2*	Length(m)
SM3L-041AA◇D△ SM3L-042AA◇D△ SM3L-061AA◇D△ SM3L-062AA◇D△ SM3L-083AA◇D△ SM3L-084AA◇D△ SM3M-062AA◇D△ SM3M-083AA◇D△	Encoder cable with battery (Absolute encoder motor)	2639-0100 2639-0200 2639-0300 2639-0400 2639-0500 2639-0800 2639-1000 2639-1500 2639-2000	2639-0100-C10 2639-0200-C10 2639-0300-C10 2639-0400-C10 2639-0500-C10 2639-0800-C10 2639-1000-C10 2639-1500-C10 2639-2000-C10	1 2 3 4 5 8 10 15 20
SM3L-041A□◇D△ SM3L-042A□◇D△ SM3L-061A□◇D△ SM3L-062A□◇D△ SM3L-083A□◇D△ SM3L-084A□◇D△ SM3M-062A□◇D△ SM3M-083A□◇D△	Encoder cable for incremental encoder motor(only for encoder type1,3)	2640-0100 2640-0200 2640-0300 2640-0400 2640-0500 2640-0800 2640-1000 2640-1500 2640-2000	2640-0100-C10 2640-0200-C10 2640-0300-C10 2640-0400-C10 2640-0500-C10 2640-0800-C10 2640-1000-C10 2640-1500-C10 2640-2000-C10	1 2 3 4 5 8 10 15 20
SM3L-041AB◇D△ SM3L-042AB◇D△ SM3L-061AB◇D△ SM3L-062AB◇D△ SM3L-083AB◇D△ SM3L-084AB◇D△ SM3M-062AB◇D△ SM3M-083AB◇D△	Encoder cable without battery (Absolute encoder motor)	2641-0100 2641-0200 2641-0300 2641-0400 2641-0500 2641-0800 2641-1000 2641-1500 2641-2000	2641-0100-C10 2641-0200-C10 2641-0300-C10 2641-0400-C10 2641-0500-C10 2641-0800-C10 2641-1000-C10 2641-1500-C10 2641-2000-C10	1 2 3 4 5 8 10 15 20
SM3L-041A□◇D△ SM3L-042A□◇D△ SM3L-061A□◇D△ SM3L-062A□◇D△ SM3L-083A□◇D△ SM3L-084A□◇D△ SM3M-062A□◇D△ SM3M-083A□◇D△	Motor power cable	1645-0100 1645-0200 1645-0300 1645-0400 1645-0500 1645-0800 1645-1000 1645-1500 1645-2000	1645-0100-C10 1645-0200-C10 1645-0300-C10 1645-0400-C10 1645-0500-C10 1645-0800-C10 1645-1000-C10 1645-1500-C10 1645-2000-C10	1 2 3 4 5 8 10 15 20
SM3L-041A□BD△ SM3L-042A□BD△ SM3L-061A□BD△ SM3L-062A□BD△ SM3L-083A□BD△ SM3L-084A□BD△ SM3M-062A□BD△ SM3M-083A□BD△	Motor brake cable	1646-0100 1646-0200 1646-0300 1646-0400 1646-0500 1646-0800 1646-1000 1646-1500 1646-2000	1646-0100-C10 1646-0200-C10 1646-0300-C10 1646-0400-C10 1646-0500-C10 1646-0800-C10 1646-1000-C10 1646-1500-C10 1646-2000-C10	1 2 3 4 5 8 10 15 20

1* □represents the encoder type   ◇represents with or without brake   △represents weather assembling seal
2* Flexible-C10 10 million bending tests
Conditions: bending radius 50mm, frequency 40 times/min, stroke 1000mm

Motor P/N 1*	Cable Type	Normal Type	Flexible Type 2*	Length(m)
SM3M-132AA◇MV	Encoder cable with battery (Absolute encoder motor)	2642-0100	2642-0100-C10	1
SM3M-133AA◇MV		2642-0300	2642-0300-C10	3
SM3M-134AA◇MV		2642-0500	2642-0500-C10	5
SM3H-132AA◇MV		2642-1000	2642-1000-C10	10
SM3H-133AA◇MV		2642-1500	2642-1500-C10	15
SM3H-134AA◇MV		2642-2000	2642-2000-C10	20
SM3M-132AA◇MV	Encoder cable for incremental encoder motor	2643-0100	2643-0100-C10	1
SM3M-133AA◇MV		2643-0300	2643-0300-C10	3
SM3M-134AA◇MV		2643-0500	2643-0500-C10	5
SM3H-132AA◇MV		2643-1000	2643-1000-C10	10
SM3H-133AA◇MV		2643-1500	2643-1500-C10	15
SM3H-134AA◇MV		2643-2000	2643-2000-C10	20
SM3M-132AANMV	Motor power cable	2647-0100	2647-0100-C10	1
SM3M-133AANMV		2647-0300	2647-0300-C10	3
SM3M-134AANMV		2647-0500	2647-0500-C10	5
SM3H-132AANMV		2647-1000	2647-1000-C10	10
SM3H-133AANMV		2647-1500	2647-1500-C10	15
SM3H-134AANMV		2647-2000	2647-2000-C10	20
SM3M-132AABMV	Motor power cable with brake cable(without water protection)	1648-0100	1648-0100-C10	1
SM3M-133AABMV		1648-0300	1648-0300-C10	3
SM3M-134AABMV		1648-0500	1648-0500-C10	5
SM3H-132AABMV		1648-1000	1648-1000-C10	10
SM3H-133AABMV		1648-1500	1648-1500-C10	15
SM3H-134AABMV		1648-2000	1648-2000-C10	20
SM3M-132AABMV	Motor power cable with brake cable(IP65 protection)	1649-0100	1649-0100-C10	1
SM3M-133AABMV		1649-0300	1649-0300-C10	3
SM3M-134AABMV		1649-0500	1649-0500-C10	5
SM3H-132AABMV		1649-1000	1649-1000-C10	10
SM3H-133AABMV		1649-1500	1649-1500-C10	15
SM3H-134AABMV		1649-2000	1649-2000-C10	20

1* ◇ represents with or without brake
2* Flexible-C10 10 million bending tests
Conditions: bending radius 50mm, frequency 40 times/min, stroke 1000mm

2.5.2 Drive Connector kit

Item	P/N	Description
I/O Connector	M2-50P	CN2，50pin Soldering I/O Connector，-F/-R type only
	MSOP-CN226P	CN2，26pin Plug-in I/O Connector，-X/-N type only
Encoder Connector	MSOP-CN310P	CN3，Drive side encoder connector
Second Encoder Connector	MSOP-CN408P	CN4，Full closed loop encoder connector
STO Connector Kit	STO Connector Kit	CN5，STO connector kit
Drive Connector Kit	Drive Connector Kit	P1、P2，Power connector

2.5.3 Absolute Encoder Battery kit

Item	P/N	Description
Absolute encoder battery	MSOP-BA01	Only for absolute encoder with battery type

2.5.4 Communication Cables

Item	P/N	Length(m)	Description
USB cable	2620-150	1.5	CN1，Connect drive and PC for configuration
IN(CN7)/OUT(CN6) Communication cable	2012-030	0.3	Twisted pair, non-shielded, communication cable between drive and controller, communication cable between servo drive
	2012-300	3	
	2013-030	0.3	Twisted pair, shielded, communication cable between drive and controller, communication cable between servo drive
	2013-300	3	

2.5.5 Other Cables

Item	P/N	Length(m)	Description
I/O Cable	1644-100	1	CN2，50pin Soldering type I/O connector cable
	1644-200	2	
	1644-300	3	
Second encoder cable	1643-300	3	Ordinary type, no need for bending times
	1643-500	5	
	1643-300-C05	3	Flexible type, 5 million times of bending
	1643-500-C05	5	

2.5.6 Regeneration Resistor

P/N	Spec.	Description
REG100W120R	100W,120ohm	Regeneration Resistor
REG200W120R	200W,120ohm	
REG300W120R	300W,120ohm	

3 Installation

3.1 Storage Conditions

3.1.1 Drive Storage Conditions

● Correctly packaged and store in a clean and dry place, avoid direct sunlight
● Store within an ambient temperature range of -10℃～+65℃
● Store within a relative humidity rang of 10% to 85% and non-condensing
● DO NOT store in a place subjected to corrosive gasses

3.1.2 Motor Storage Conditions

● Correctly packaged and stored in a clean and dry place, avoid direct sunlight
● Store within an ambient temperature range of -20℃～+65℃
● Store within a relative humidity rang of 20% to 85% and non-condensing
● DO NOT store in a place subjected to corrosive gasses

3.2 Installation Conditions

### 3.2.1 The drive operation ambient conditions are as follows:

● The ambient temperature is 0℃～50℃. If the ambient temperature exceeds 45°C, please place it in a well-ventilated place. It is recommended to keep the ambient temperature below 45℃ for long-term operation to ensure the reliable performance of the product.
● If this product is installed in a cabinet, the size and ventilation conditions of the cabinet must be sure that there is no danger of overheating of all electronic devices used inside.
● Ambient humidity is 10%～85% RH, no condensation.
● Vibration below 9.8m/s2, 10～60Hz (can not be used continuously at the resonance point).
● Do not use the drive near corrosive gas, flammable gas, or combustible materials.
● Please install the drive in an indoor electrical control box without water or direct sunshine.
● Please avoid using the drive in dusty places.

3.2.2 The motor operation ambient conditions are as follows:

● The ambient temperature is 0℃～40℃.
● Ambient humidity is 10%～85% RH, no condensation.
● Vibration below 49m/s^2.
● Do not use the motor near corrosive gas, flammable gas, or combustible materials.
● Do not use the motor in a closed environment, the closed environment will cause the motor to high temperature and shorten the service life.

3.3 Drive Installation Space

● When installing the drive, please reserve enough around space for the drive to ensure a good circulating cooling effect.

● Do not block the cooling holes of the drive.

● To ensure the temperature in the cabinet, it is recommended to install a cooling fan in the cabinet.

● Please ground the drive well during installation.
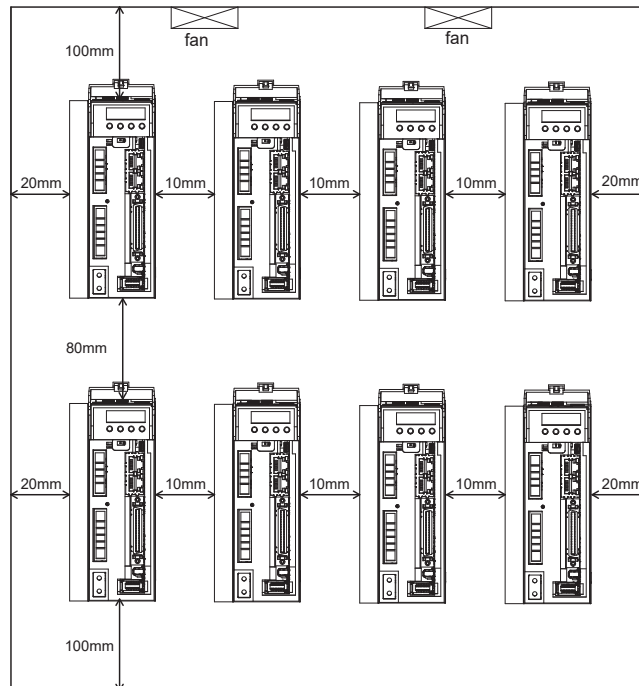
3.4 Motor Installation

3.4.1 Encoder and Bearing Protection

● DO NOT strike the motor when mounting as the motor shaft or encoder may be damaged.

● It is recommended to use a disturbing coupling specially designed for servo motors, which can provide some cushioning during eccentricity or deflection.

● When installing the coupling, please wipe clean the anti-rust oil on the output shaft end of the motor.

● When using the keyway motor, please use the standard key in the motor box.

● When installing a pulley on a servo motor with a keyway, please use the threaded hole of the motor shaft to push the pulley into the motor shaft with a screw.
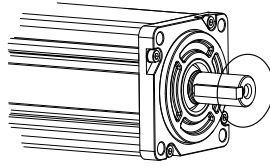
- When disassembling the pulley, please use professional tools such as pulley remover to prevent the bearing from being injured.
- When connecting the shaft, make sure to achieve the required concentricity. If the concentricity is not good, it will produce vibration and damage the bearing and encoder.
- The load applied in the axial or radial direction of the motor should not exceed the range specified in the specifications, please refer to the specifications table of each servo motor.
- The output shaft material of the servo motor does not have the ability to prevent rust. Although grease has been used for rust protection before leaving the factory, if the storage time exceeds six months, to ensure that the motor shaft is free from rust, please check the condition of the motor shaft regularly every three months and add appropriate anti-rust grease in time.

3.4.2 Precautions for the use of the motor in the oil and water environment

- Do not allow oil or water to intrude the motor
- Do not put the cable in water or oil
- Since the through part of the motor shaft is not designed with IP65 protection, please make sure that no water or oil intrudes from such parts
- Industrial-class oil seal for motor seal can block contaminants (oil, impurities) to extend the life of the motor; the oil seal will produce a certain resistance to the motor shaft, and it is recommended to use it in derating
- In liquid applications, please install the motor wiring port downwards
- When installing the oil seal, make sure that the lip of the oil seal faces outwards
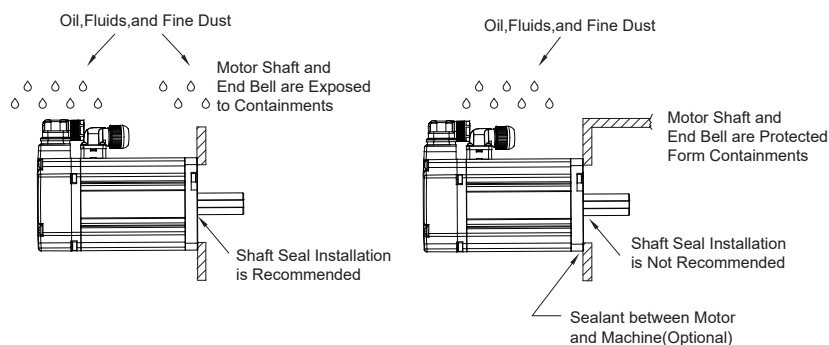
3.4.3 Wiring

● If you use cable drag chain, please use bending resistant cable, and ensure that there is a bending diameter of 100mm or more.

● Do not twist the cable.

● When moving the motor, do not pull the cable.

● Do not use the same sleeve for the main circuit cable and the input/output signal cable/encoder cable, and do not tie them together; when wiring, the main circuit cable and the input/output signal cable/encoder cable should be separated by more than 30cm.

3.4.4 Motor Temperature Rise

The rated value of the servo motor power is the continuous allowable rating when it is installed on the heat sink and the operating environment temperature is 40°C. When the servo motor is installed in a small device, the heat dissipation area of the servo motor is reduced, so the temperature may rise significantly.

The size of the heatsink is as follows:

Motor Frame Size	Power	Heatsink dimension
40mm	50W、100W	200*200*6 Aluminum
60mm	200W、400W	250*250*6 Aluminum
80mm	750W	250*250*6 Aluminum

If the installation environment is difficult to use a large radiator, or work in an ambient temperature exceeding the specification requirements, you need to follow the following requirements:

● Do not work under rated power, choose a motor that is 1 to 2 times larger than the actual motor power required

● Reduce the acceleration and deceleration of the working cycle to reduce the motor load

● Reduce the duty cycle of work

● Use a cooling fan or other methods to perform external forced air cooling of the servo motor

● When using a motor with an oil seal, the required load torque must be 70% of the rated torque of the motor

Note: Do not place any heat-insulating material between the servo motor and the metal heatsink, otherwise the motor cannot dissipate heat and cause the motor temperature to rise, which may cause the motor failure.

4 Wiring

4.1 EtherCAT Communication Port
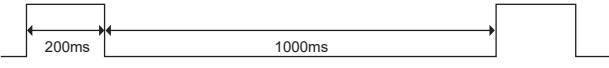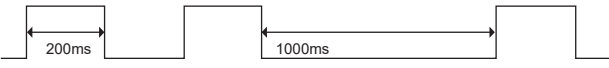
4.1.1 Communication Interface
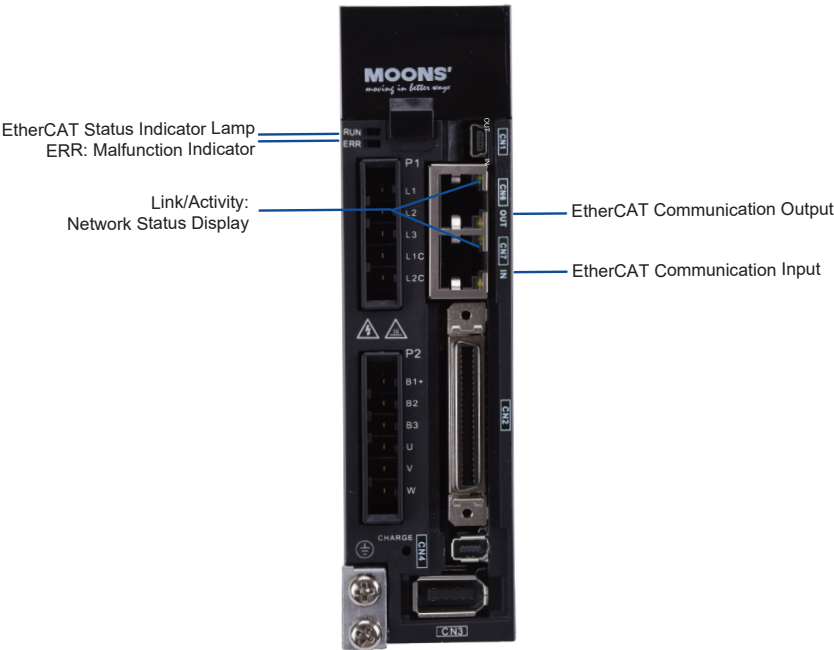
4.1.2 EtherCAT Status LED

LED	Color	Status	Description
Link/Activity	Green	OFF	No Ethernet connection
		ON	Ethernet is connected
		Flickering	Activity online
RUN	Green	OFF	Init(Initialization)
		ON	OP(Operational)
		Blinking	Pre-op(Pre-operation)
		Single Flash	Safe-Operation
ERR	Red	OFF	No error
		Blinking	General error
		Single Flash	Sync error
		Double Flash	Watch dog over time
		Flickering	Initialization Error

Notes：

Flickering	ON OFF	50ms 50ms
Blinking	ON OFF	200ms 200ms
Single Flash	ON OFF	200ms 1000ms
Double Flash	ON OFF	200ms 1000ms

4.1.3 RJ45(8p8c) connector PIN assignments

PIN1   PIN8   PIN1   PIN8
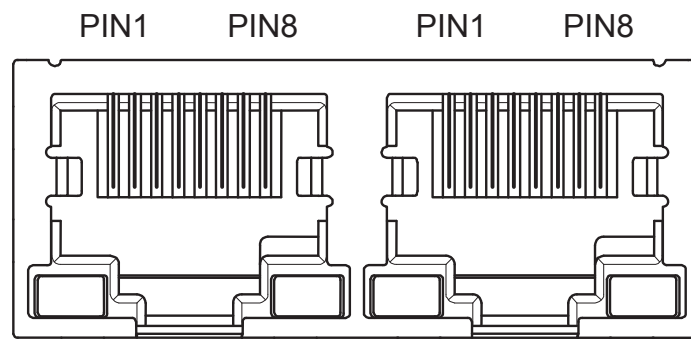
PIN NO.	Signal	Description
1	TX+	Transmit +
2	TX-	Transmit -
3	RX+	Receive +
4	-	-
5	-	-
6	RX-	Receive -
7	-	-
8	-	-

4.2 EMC Control

⚠	M3 servo drive uses high-speed switching elements inside, which will produce high-frequency or low-frequency interference during normal operation, and interfere with peripheral equipment through conduction or radiation.
	There is also a low-voltage unit inside the servo drive, which is likely to be interfered by the noise of the drive's peripheral equipment. The interfered signal may cause the device to make unexpected actions.

When installing and wiring, please follow the electromagnetic compatibility specifications described in this user manual. This product can comply with EN 61800-3 specifications.

In order to prevent the mutual electromagnetic interference between the servo drive and its peripheral equipment, the following countermeasures can be taken:

● Equipped with appropriate EMI noise filter on the power input side.
● Please make sure that the drive and motor are well grounded, and the grounding wire is preferably AWG10 or higher.
● Do not use the same sleeve for the main circuit cable and the input/output signal cable/encoder cable, and do not tie them together; when wiring, the main circuit cable and the input/output signal cable/encoder cable should be separated by more than 30cm.
● Please use twisted-pair wire or multi-core twisted-pair shielded wire for input and output signal cables and encoder cables.
● The length of the input and output signal cables is less than 3m, and the encoder cable is less than 20m.
● Do not use the same power source with electric welders, EDM machines, etc.; even if they are not the same power source, when there is a high-frequency generator nearby, please connect a noise filter to the input side of the main circuit power cable and control power cable.

4.2.1 EMI Noise Filter

Installing a noise filter in the appropriate place will minimize the noise as much as possible.
The following diagram shows an solution of wiring for noise control.
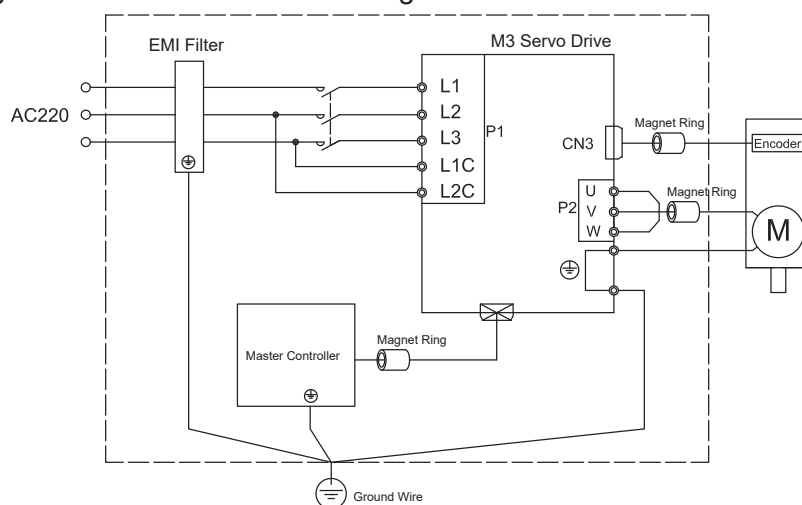
In addition to installation and wiring in accordance with the manual, you also need to pay attention to:

● Remove the paint layer on the contact surface when the drive is mounted on a metal plate.

● Servo drive and EMI filter are mounted on the same metal plate.

● Shorten the wiring length between the EMI filter and the servo drive as much as possible

● Please route the input and output wires separately, do not bundle them together.

● The noise filter must be well grounded.

● Please install the ferrite ring as shown in the figure above for the input and output signal cables and power lines of the drive to obtain better EMC effects.

4.2.2 Grounding

Good grounding treatment can give full play to the effect of EMI filter and greatly reduce interference.

● Must be parallel single-point grounding
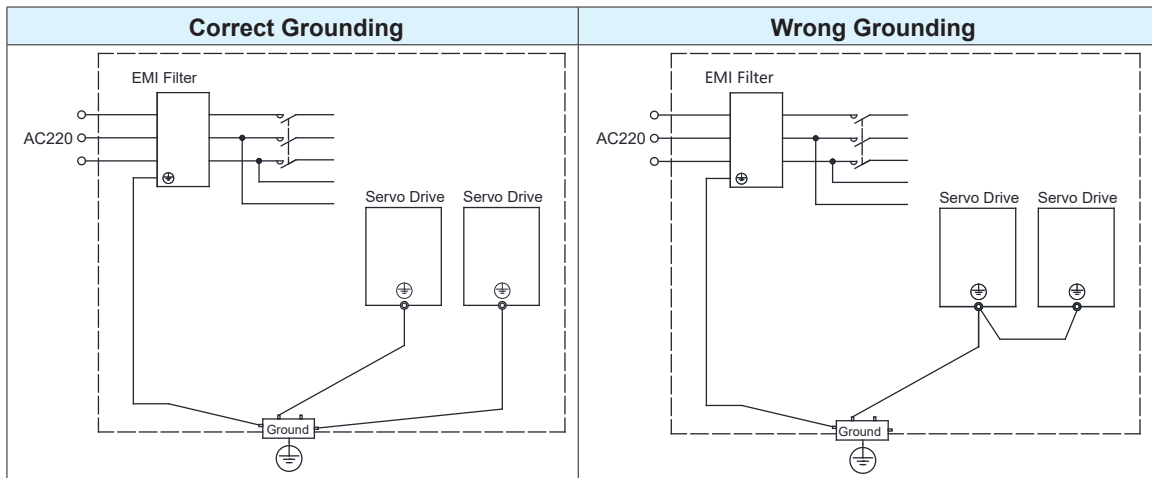
● Use a cable with a shielded net as the power extension cable between the drive and the motor.

● The shielding net of the motor power cable must be grounded or connected to the grounding terminal of the drive.

4.2.3 Motor Cable Shielding net Processing

Choosing the motor cable with shielding net and installing the shielding net correctly can obtain better EMC effect and interference suppression effect. Please note the following:

● Use a cable with shielded net (if there is a double-layer isolation layer is better)

● The shielding nets at both ends of the motor cable must be grounded with the shortest distance and maximum contact area. Use clamps to fix the shielding nets at both ends of the motor cable to the metal plane as shown in the figure below.

● The protective paint must be removed from the fixing place between the clamp and the metal plane to ensure good contact.

MOONS'
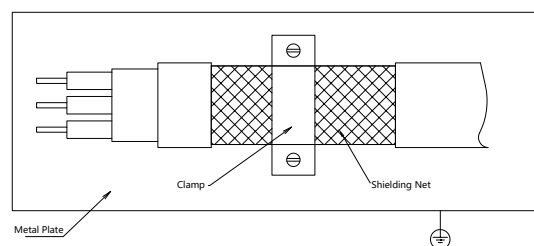
4.2.4 Recommended Model of EMI Filter

When the servo drive is running normally, electromagnetic interference will be generated. In order to prevent interference to external sensitive equipment, select appropriate EMI noise filters to minimize interference.

Note:

● Please select a noise filter that matches the power of the drive.

● Please separate the power input and output cables. Do not bundle the input and output wires together and put them in the same wire trough.
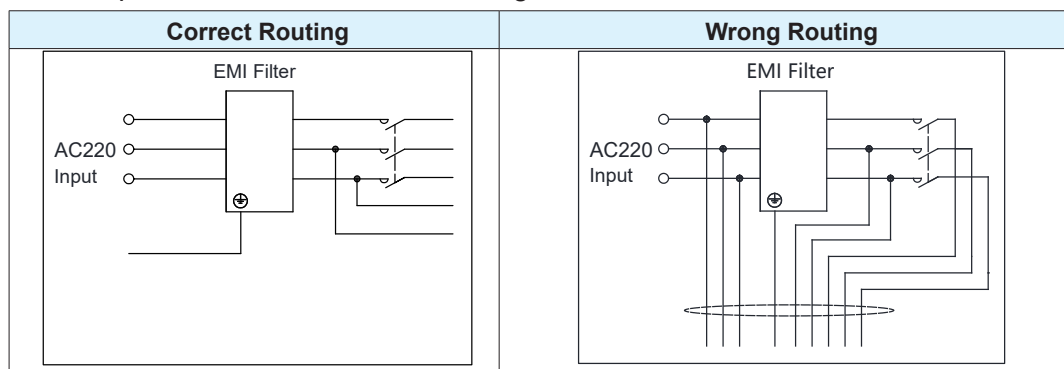
Recommended EMI Filter:

MOONS' P/N	Spec.	Manufacturer	Description
MSOP-EMI010	250VAC，10A	LCR	EMI Noise Filter

Other Recommended Part number：

Drive P/N	Main circuit power	Manufacturer	EMI Filter P/N
M3DV-21A8EC◆	Single Phase	TYCO	3ET1
M3DV-23A0EC◆		TYCO	6ET1
M3DV-24A5EC◆		TYCO	6ET1
M3DV-26A0EC◆		TYCO	10ET1
M3DV-210AEC◆	Three Phase	Dephir	DF300-16A-01
M3DV-213AEC◆		Dephir	DF300-16A-01

◆ Represents the Function type

4.2.5 Ferrite Ring

The ferrite magnetic ring can effectively absorb the radiation interference of the wire harness.

The magnetic ring has different impedance characteristics at different frequencies. Generally, the impedance is very small at low frequencies. When the signal frequency increases, the impedance shown by the magnetic ring rises sharply, which makes it easy for normal useful signals to pass through, and can effectively suppress high frequencies. The passage of interference signals solves the problem of high-frequency interference of power lines, signal lines and connectors.

When the magnetic ring suppresses common mode interference, the eddy current loss of the magnetic ring to the high-frequency signal converts the high-frequency component into heat loss, so that a low-pass filter can be formed, which makes the high-frequency noise attenuate greatly. The impedance of low-frequency useful signals can be ignored and does not affect the normal operation of the circuit.

The wire passing through the magnetic ring can be repeatedly wound on the magnetic ring to increase the inductance, thereby enhancing the use effect of the magnetic ring, but too many turns will cause excessive loss and increase the temperature of the magnetic ring.

The recommended winding method and number of turns are as follows:

Signal cable	Wind cables the 2-3 turns to form the signal noise filter.
Motor cable	Remove the cables jacket to the length so that wires can be wound on the clamp noise filter for 2-3 turns. For effective noise reduction, U/V/W should be wound
Encoder cable	Wind cables the 2-3 turns to form the signal noise filter.
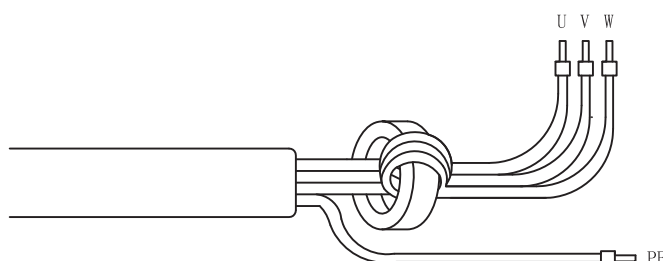
Recommended Ferrite ring：

MOONS' P/N	P/N	Manufacturer
M2-OP3035	ZCAT3035-1330	TDK

4.3 External Main Circuit Wiring

4.3.1 System Configuration

Function Type：F type、R type

AC Power

Non Fuse Breaker

Line Filter (optional)

Electromagnetic Contactor

Main Power Input

Control Power Input

Regenative Absorbing Resistor

Motor Power Cable

Ground (PE)

Motor Encoder Cable

LED Display
The 5 digit, 7 segment LED displays the diver status and faults.
Operation Panel
Function keys are used to perform status display, monitor and diagnostic, function and parameter setting.

USB Communication (software configuration)

CN1

Communication Port

CN6

CN7

EtherCAT Controller

Only for bus type

CN2

I/O Interface
Used to connect PLC, motion card and other controllers.

CN4

Second Encoder Interface
Full Closed-loop Function

Battery box is suitable for 20-bit absolute optical encoder motor

STO Interface *1

Note：*1 Certain models don't support this function, please refer to page 10.

Function Type：X type、N type

AC Power

Non Fuse Breaker

Line Filter (optional)

Electromagnetic Contactor

Main Power Input

Control Power Input

Regeneration Absorbing Resistor

Motor Power Cable

LED Display
The 5 digit, 7 segment LED displays the diver status and faults.

Operation Panel
Function keys are used to perform status display, monitor and diagnostic, function and parameter setting.

MOONS'
moving in better ways

RUN
ERR

P1
L1
L2
L3
L1C
L2C

P2
B1+
B2
B3
U
V
W

CHARGE

CN4

CN3

Ground (PE)

USB Communication (software configuration)

Communication Port

CN1

CN6

CN7

RS-485
EtherCAT Controller

Only for bus type

CN2

I/O Interface
Used to connect PLC, motion card and other controllers.

CN4

Second Encoder Interface
Full Closed-loop Function

Battery box is suitable for 20-bit absolute optical encoder motor

Motor Encoder Cable

STO Interface *1

Note：*1 Certain models don't support this function, please refer to page 10.

4.3.2 Servo Drive Connectors and Terminals

| Terminal Identification	Description	Details		
P1	L1、L2、L3	Used to connect three-phase AC main circuit power		
	L1C、L2C	Used to connect single-phase AC for control circuit power		
P2	U、V、W	Used to connect servo motor		
		Terminal Symbol	Wire color	Description
		U	Red	Connecting to three-phase motor main circuit cable
		V	Yellow	
		W	Blue	
	B1+、B2、B3	Internal Resistor	Ensure the circuit is closed between B2 and B3, and the circuit is open between B1+ and B3.	
		External Resistor	Ensure the circuit is open between B2 and B3, and connect the external regenerative resistor between B1+ and B2.	
CN1	Mini USB Port	Connect to PC		
CN2	I/O Connector	Used to connect external controllers		
CN3	Encoder Connector	Used to connect encoder of servo motor		
CN4	Second encoder input	Second feedback input for full closed loop control		
CN5	STO Connector	STO function		
IN(CN7)	EtherCAT IN Port	EtherCAT Input port		
OUT(CN6)	EtherCAT OUT Port	EtherCAT output port		

4.3.3 Connections and Wiring Notes

● Please ensure grounding wires are securely connected, wires with more than AWG 10(5.3mm2) on sectional area is recommended.

● Grounding method must be single point grounding.

● Ensure L1/L2/L3 and L1C/L2C are correctly wired, and voltage supplies are within the specification range.

● When using single-phase power supply, please connect to the L1, L2/L3 pins.

● Ensure U/V/W is following the order of RED/YELLOW/BLUE. Wrong connections will cause motor stop rotation, or wrong rotatory directions.

● Isolation transformer and EMI filter are recommended on drive's power supply to ensure safety and improve its anti-interference level.

● Please setup an emergence stop circuitry to switch off the power supply when fault occurs.

● Please DO NOT touch drive or motor's connector terminals 5 minutes after drive and motor is powered off. There are electrical charge components in the circuitry. Therefore, even power is off, there might still be hazardous voltages within the circuitry, before its total discharge.

● Install the encoder cables in a separate conduit from the motor power cables to avoid signal noise. Separate the conduits by 30cm above.

● Use multi-stranded twisted-pair wires or multi-core shielded-pair wires for signal, encoder feedback cables.

● The maximum length of signal input/output cable is 3 meters, and the maximum length of encoder (PG) feedback cables is 20 meters.

4.3.4 Precautions for the use of towline cables

When you need to move the motor cable or install the cable in a drag chain, please use a dedicated flexible cable. Ordinary cables are easy to be damaged during repeated bending, causing the servo motor to fail to work normally.

When using drag chain cables, make sure that:

● Correctly choose the cable that meets the required bending resistance .

● The bending radius of the cable is generally more than 10 times the outer diameter of the cable.

● Avoid pulling the cable. When wiring inside the drag chain, do not fix or bundle it, so as to avoid the bending radius is not enough and the cable will be pulled .

● Please bundle the cables at the two ends of the drag chain and the fixed place of the mechanical part.
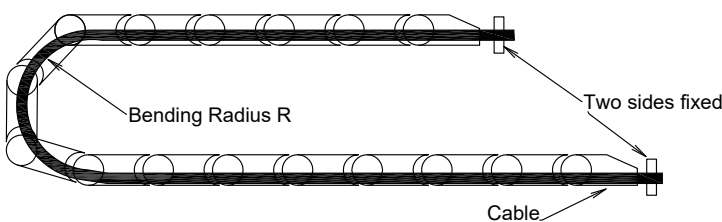
● The wiring in the drag chain should not be too dense to ensure that the cable occupies less than 60% of the internal space of the drag chain.

● Avoid mixing cables with large outer diameter differences. If you really need to mix cables, please install baffles.

4.3.5 Recommended Wire

● The main circuit is recommended to use insulated wires with a withstand voltage of 600V and above 75°C.

● Be sure to choose the corresponding allowable current cable to prevent the cable from overheating.

● Recommended wires for each part of the drive are as follows:

Drives and Motors		Rated Power (W)	Diameter of cable(AWG)						
			Connector P1		Connector P2		Connector CN3		
			L1/L2/L3	L1C/L2C	U/V/W	B1+,B3	Encoder	Brake	Grounding
M3DV-21A8EC◆	SM3L-041A□◇D△	50	0.75 ~ 2.0mm² (AWG14 ~ 18)	0.75 ~ 2.0mm² (AWG14 ~ 18)	0.75 ~ 2.0mm² (AWG14 ~ 18)	1.25 ~ 2.0mm² (AWG14 ~ 16)	0.2mm² (AWG24)	0.5mm² (AWG16)	2.0 ~ 5.3mm² (AWG10 ~ 14)
	SM3L-042A□◇D△	100							
	SM3L-061A□◇D△	200							
M3DV-23A0EC◆	SM3L-062A□◇D△	400							
	SM3M-062A□◇D△								
M3DV-24A5EC◆	SM3L-083A□◇D△	750							
	SM3M-083A□◇D△								

◆Motor Type, □Encoder Type, ◇Brake or not, △Oil seal or not

● Please use insulated pin terminals for power connectors P1 and P2

◆ Crimp Type	◆ Sleeve Type	◆ Parallel terminal

● Please select the pin terminal according to the recommended wire

Connector applicable wire type: AWG14～AWG18

The outer diameter of the wire for the connector: 2.1～4.2mm in diameter

4.3.6 Grounded PIN

● In order to obtain a better EMC effect, please use 5.3mm2/AWG10 dedicated copper conductor cable

● Please use O-shaped cold-pressed terminals

● Ground terminal tightening torque

Drive P/N	Grounding Screw	
	Screw Spec.	Tightening Torque
M3DV-21A8EC◆		
M3DV-23A0EC◆	M4	1.4 N.m
M3DV-24A5EC◆		

◆ Represents the Function type

Notes:

● Exceeding the maximum tightening torque will cause damage to the screw hole.

● Do not install the grounding screw when the power is on, it may cause electric sparks.

● Please regularly check whether the grounding screw is loose.

4.4 Wiring For Power Supply P1

220V AC servo drive supports single phase or three phase wiring method. Three phase wiring method for 1000W or above drives is recommended.

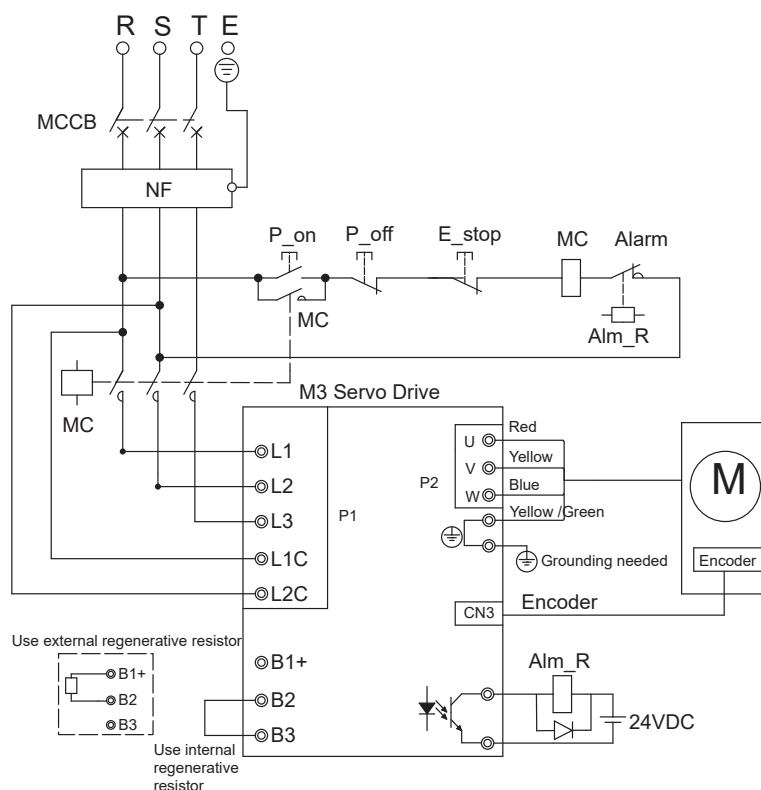### 4.4.1 Single-Phase Power Supply Connection(AC220V)
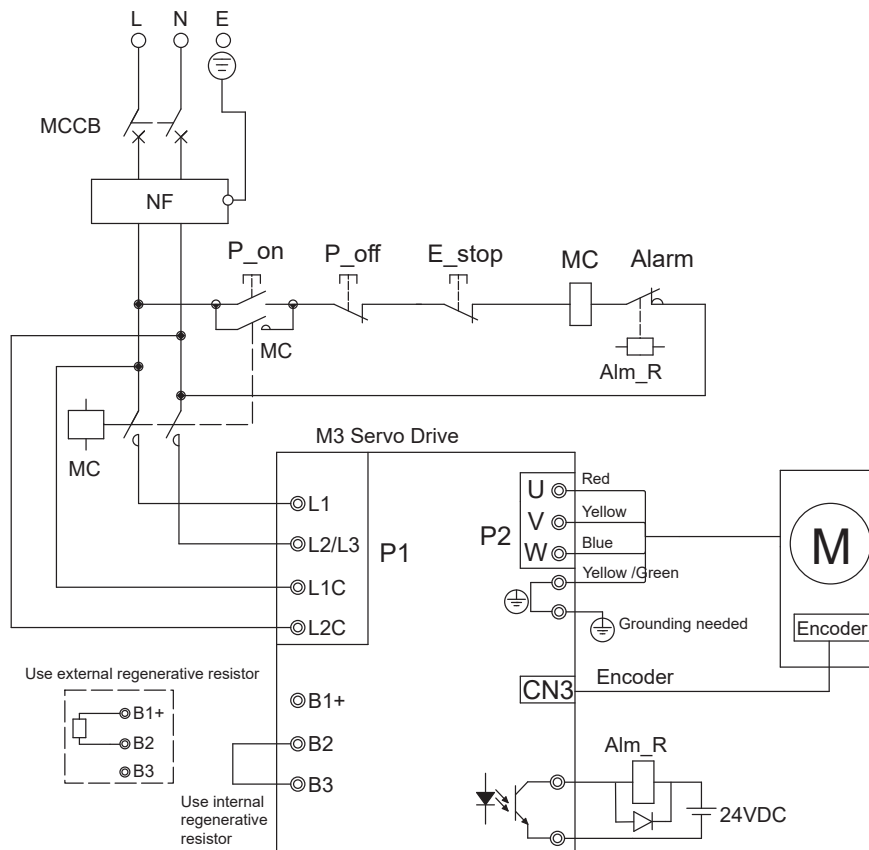
Notes：

| Symbol	Description	Symbol	Description
MCCB	Circuit Breaker	E_stop	Emergency Stop Switch
NF	EMI Noise Filter	MC	Magnetic Contactor
P_on	Power On Switch	Alm_R	Alarm Relay
P_off	Power Off Switch	Alarm	Alarm Relay Contactor

■ Peripheral equipment capacity for wiring

Drive	Voltage (VAC)	Motor Rated output Power(W)	Drive Power capacity kVA (Rated Load)	Circuit Breaker Rated Current (A)	Contactor Rated Current(A)
M3DV-21A8EC◆	Single-Phase 220	50	0.3	6	9A (3P+1a)
		100	0.4		
		200	0.5		
M3DV-23A0EC◆		400	0.9	10	
M3DV-24A5EC◆		750	1.3	16	

◆ Represents the Function type

4.4.2 Three-Phase Power Supply Connection(AC220V)

Note: Three-phase 220V is the line voltage

Notes：

Symbol	Description	Symbol	Description
MCCB	Circuit Breaker	E_stop	Emergency Stop Switch
NF	Noise Filter	MC	Magnetic Contactor
P_on	Power On Switch	Alm_R	Alarm Relay
P_off	Power Off Switch	Alarm	Alarm Relay Contactor

■ Peripheral equipment capacity for wiring

Drive	Voltage (VAC)	Motor Rated output Power(W)	Drive Power capacity kVA (Rated Load)	Circuit Breaker Rated Current (A)	Contactor Rated Current(A)
M3DV-21A8EC◆	Three-Phase 220	50	0.3	4	9A (3P+1a)
		100	0.4		
		200	0.5		
M3DV-23A0EC◆		400	0.9	6	
M3DV-24A5EC◆		750	1.3	10	
M3DV-26A0EC◆		850	1.8		
		1000	1.8		
M3DV-210AEC◆		1300	2.3	16	
		1500	2.3		
M3DV-213AEC◆		1800	3.3		
		2000	3.3		

◆ Represents the Function type
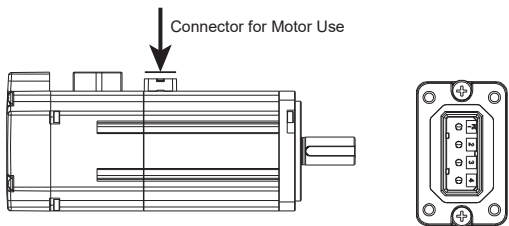
4.5 Wiring to the Connector P2

4.5.1 Motor Power Cable Configuration
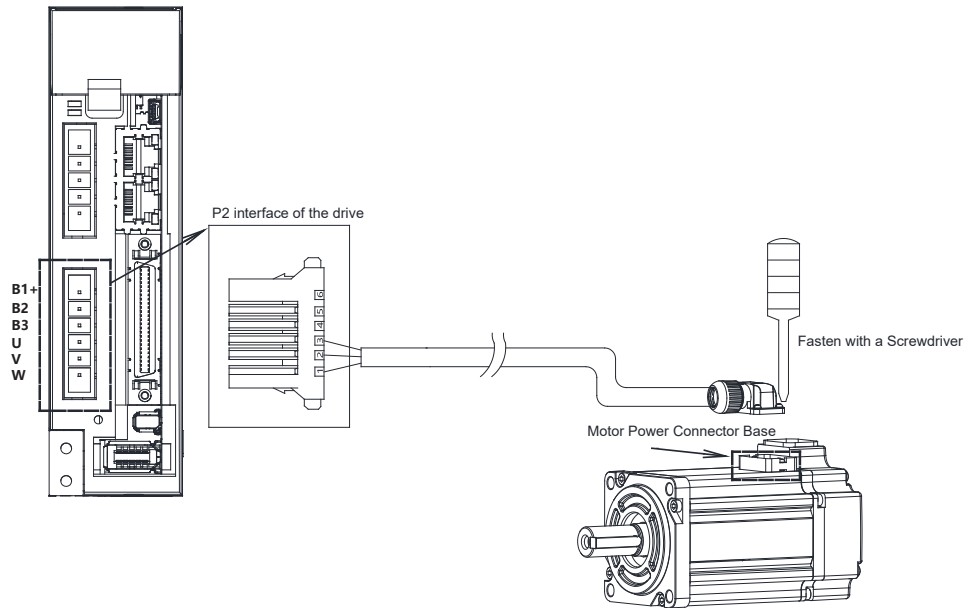
4.5.2 Motor Power Cable Connector Specifications

■ PIN Assignment

Motor P/N	PIN.No	Item	Definition
SM3L-041A□◇D△	1	PE	Ground
SM3L-042A□◇D△			
SM3L-061A□◇D△	2	U	U Phase
SM3L-062A□◇D△			
SM3L-083A□◇D△	3	V	V Phase
SM3L-084A□◇D△			
SM3M-062A□◇D△	4	W	W Phase
SM3M-083A□◇D△			

□Encoder Type ◇Brake or not △Oil seal or not

4.5.3 Motor Power Cable Connector Specifications

■ PIN Assignment
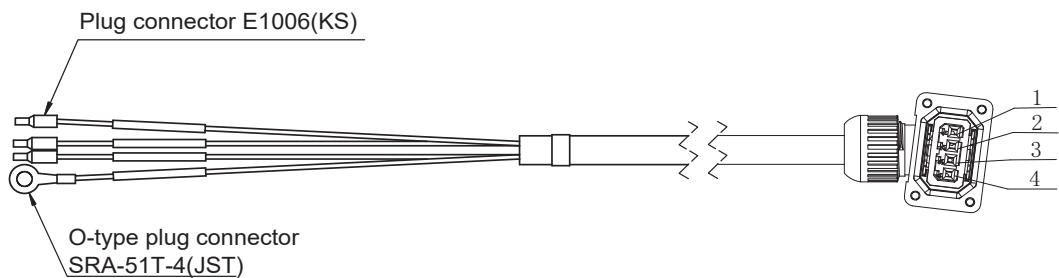
Motor P/N	Drive side	Signal	Color	Motor side
	(JST)061JFAT-SBXGF-I			DGFA4S-B1-00A(H)
SM3L-041A□◇D△	Grounding Screw	PE	Yellow/Green	1
SM3L-042A□◇D△				
SM3L-061A□◇D△	3	U	Red	2
SM3L-062A□◇D△				
SM3L-083A□◇D△	2	V	Yellow	3
SM3L-084A□◇D△				
SM3M-062A□◇D△	1	W	Blue	4
SM3M-083A□◇D△				

□Encoder Type ◇Brake or not △Oil seal or not

NOTE: Ensure U/V/W is following the order of RED/YELLOW/BULE. Wrong connections will cause motor stop rotation, or wrong rotary directions.

4.6 Encoder Connector CN3

4.6.1 Motor Encoder Feedback Cable Configuration
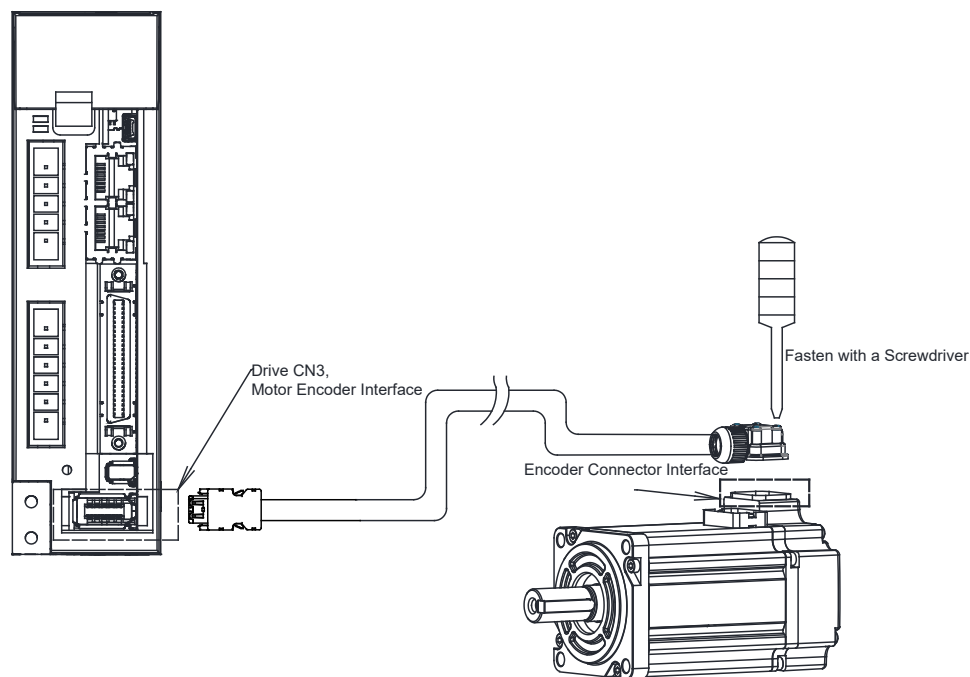
4.6.2 Motor Encoder Connector Specification

■ PIN Assignment
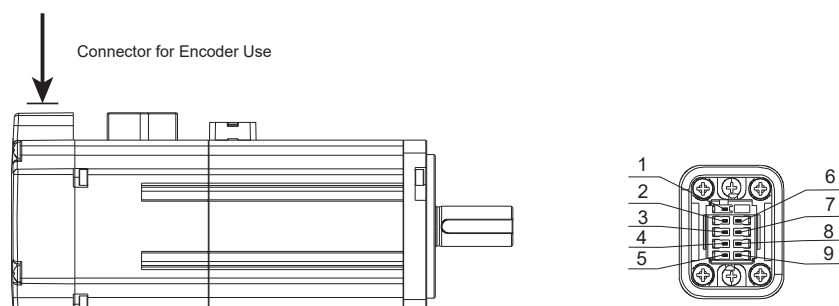
Motor P/N			PIN.No	Symbol	Description
SM3L-041AA◇D△	SM3L-041A1◇D△	SM3L-041A3◇D△	1	Shield	Shield
SM3L-042AA◇D△	SM3L-042A1◇D△	SM3L-042A3◇D△	2	--	--
SM3L-061AA◇D△	SM3L-061A1◇D△	SM3L-061A3◇D△	3	VCC	Encoder Power 5Vdc
SM3L-062AA◇D△	SM3L-062A1◇D△	SM3L-062A3◇D△	4	VBAT	Encoder Battery V+
SM3L-083AA◇D△	SM3L-083A1◇D△	SM3L-083A3◇D△	5	SD+	Encoder data +
SM3L-084AA◇D△	SM3L-084A1◇D△	SM3L-084A3◇D△	6	--	--
			7	VCC_GND	Encoder Power GND
SM3M-062AA◇D△	SM3M-062A1◇D△	SM3M-062A3◇D△	8	VBAT_GND	Encoder Battery V-
SM3M-083AA◇D△	SM3M-083A1◇D△	SM3M-083A3◇D△	9	SD-	Encoder data -

Motor P/N	PIN.No	Symbol	Description
SM3L-041AB◇D△	1	--	--
SM3L-042AB◇D△	2	CLK+	CLK+
SM3L-061AB◇D△	3	CLK-	CLK-
SM3L-062AB◇D△	4	DATA-	Encoder data -
SM3L-083AB◇D△	5	DATA+	Encoder data +
SM3L-084AB◇D△	6	5V	Encoder Power 5Vdc
SM3M-062AB◇D△	7	--	--
SM3M-083AB◇D△	8	GND	Encoder Power GND
	9	--	--

◇Brake or not △Oil seal or not

Note: DO NOT connect the UN-defination PINs

4.6.3 Motor Encoder Wire Connection Definition

■ PIN Assignment
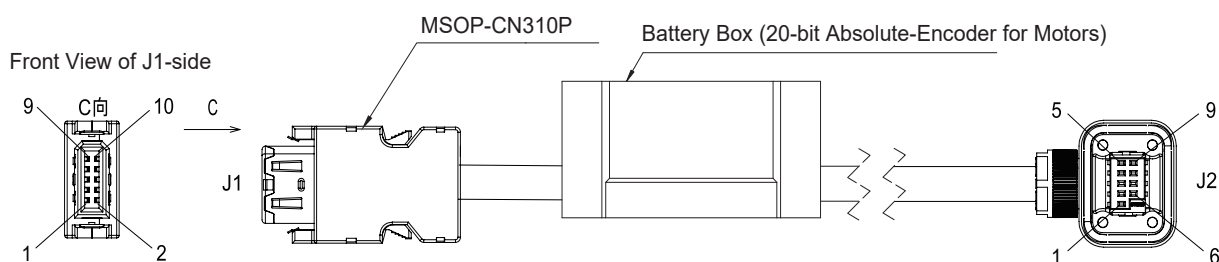
Motor P/N	Drive side J1	Battery	Signal	Color	Motor side J2
SM3*-***AA◇D△ SM3*-***A1◇D△ SM3*-***A3◇D△	1	--	VCC	Red	3
	2	--	VCC_GND	Black	7
	--	Vbat+	VBAT	Green	4
	--	Vbat-	VBAT_GND	Orange	8
	9	--	SD-	Blue/Black	9
	10	--	SD+	Blue	5
	--	--	Shield		1

Motor P/N	Drive side J1	Signal	Color	Motor side J2
SM3*-***AB◇D△	1	VCC	Red	6
	2	VCC_GND	Black	8
	7	CLK-	Yellow/Black	3
	8	CLK+	Yellow	2
	9	DATA-	Blue/Black	4
	10	DATA+	Blue	5

◇Brake or not △Oil seal or not

Note: DO NOT connect the UN-defination PINs

4.6.4 Battery of Absolute Encoder

When the M3 series 20-bit absolute encoder motor is used in a multi-turn absolute value system, it needs to use battery power to record multi-turn data when the drive is powered off. After power-on, the drive calculates the absolute position of the mechanical load through the absolute position of the encoder. There is no need to repeat the mechanical homing operation.

When using our company's encoder cable with a battery box, the battery box has a built-in battery MSOP-BA01, which meets the UL lithium battery standard and the IEC lithium battery international safety standard. Please refer to the figure below for the battery dimensions.

■ Battery replacement.

There is a risk of electrolyte leakage after long-term use of the battery. It is recommended to replace the battery every two years. It is recommended to replace the battery when the drive is powered on, otherwise the absolute position of the encoder will be lost due to no power supply after the battery is removed.

■ Battery selection

Please refer to the information in the table below to select a battery of appropriate specifications.

| Battery Spec.	Item	Rated Value			Description
		Min.	Typical	Max.	
Output Spec. 3.6V，2.7Ah	Battery Voltage(V)	3.3	3.6	5	Standby work
	Battery low Voltage(V)		2.8		
	Battery alarm Voltage(V)		3.2		
	Current consumption(μA)		2		During normal work
			10		During standby operation, the shaft is stationary
			30		During standby operation, the shaft rotates
	Operation Ambient(℃)	0		40	Same as the ambient temperature of motor
	Storage Ambient(℃)	-20		60	

■ Precautions for battery use

1. Connect the positive and negative electrodes correctly.

2. If a battery that has been used for a long time or an unusable battery is installed in the machine, liquid leakage may occur. It will not only corrode the surrounding parts, but also has the risk of short circuit. It is recommended to replace it regularly (reference period: it is recommended to replace it every two years).

3. It is forbidden to disassemble the battery to prevent the electrolyte from flying and affecting personal safety.

4. It is forbidden to throw the battery into the fire to avoid the danger of explosion.

5. It is strictly forbidden to short-circuit between the positive and negative electrodes of the battery

6. It is forbidden to charge the battery.

7. It is forbidden to solder directly on the surface of the battery, and the battery with solder feet or leads should be used.

8. Please discard the replaced battery according to local regulations.

4.7 Electromagnetic Brake

Servo motors are used in applications such as vertical axes. When the motor is disabled or powered off, to prevent the mechanical mechanism driven by the motor from falling due to gravity and other reasons, it is necessary to use a servo motor with an electromagnetic brake.

Note: The brake of the servo motor can only be used to maintain the position of the motor when the motor is not enabled or power-off. Do not use it for braking during deceleration, otherwise the motor will be damaged.

4.7.1 Wiring Diagram
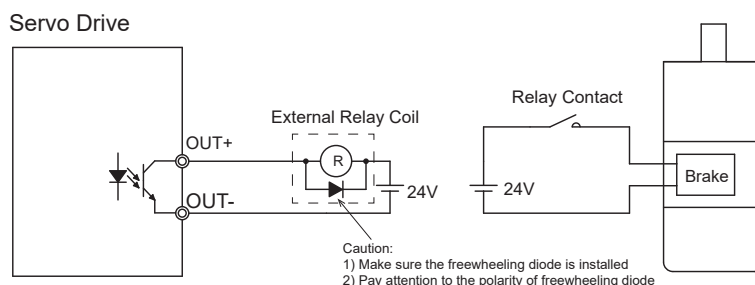
4.7.2 Precautions for the use of brake

● The signal of the drive control brake can not directly drive the motor's brake. The external 24V power supply and relay must be provided. It is best to try a separate 24V power supply to prevent other equipment from causing abnormal power supply which will eventually cause the motor brake to malfunction.

● The digital output signal of the driver is an optocoupler output, the maximum is 30VDC, 30mA. When controlling inductive loads such as relays, be sure to install a freewheeling diode, otherwise the output pin circuit of the driver will be damaged and the signal will not be output normally.

● The electromagnetic brake is a normally closed type, and the motor shaft cannot rotate when the brake is not powered

● Electromagnetic brake has no polarity requirement

● Avoid the voltage drop as the wire is too thin

● The brake specifications are as follows:

Frame Size	40mm	60mm	80mm
Holding Torque(N.m)	0.32	1.5	3.2
Rated Voltage VDC	24		
Power W(20℃)	6.3	7.2	9.6
Working Current A	0.26	0.3	0.4
Engage Time	Standard air gap below 20℃<70ms		
Release Time	<25ms		
Release Voltage	18.5VDC max.(at 20℃)		

4.7.3 The Timing Charts of Electromagnetic Brake

Since the brake has a delay in action, in order to avoid damage to the brake, it is necessary to pay attention to the action sequence during use. When working in CSP, CST and CSV control modes, the P5-24 parameter setting value is invalid. When designing the control program, be sure to allow enough time to ensure that the brake is opened before controlling the motor movement, otherwise the motor brake will be damaged.
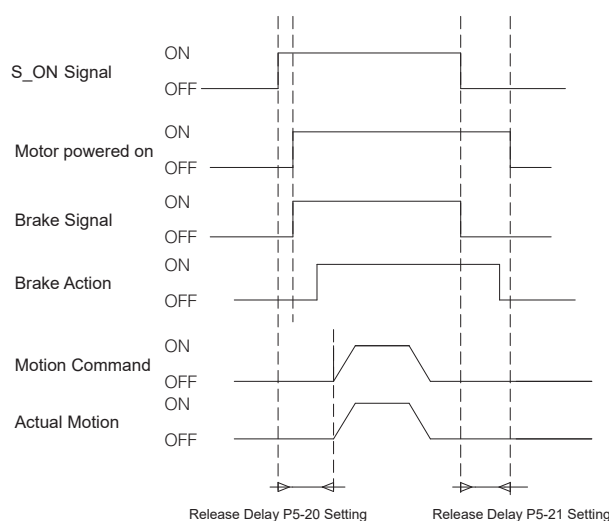
Motion waiting time and disable delay time can be set using Luna software, or by modifying parameters P5-24 and P5-25 through the panel.

4.8 Regeneration Resistor P2

When the output torque of the motor shaft is opposite to the direction of rotation, the energy is fed back from the motor load end to the drive bus capacitor, making the bus voltage value increase. When it rises to the braking voltage point, the energy can only be consumed by the regeneration resistor, otherwise it will damage the servo drive. The regeneration resistor can be built-in or externally connected by the user and the built-in and external regeneration resistors cannot be used at the same time. The related specifications of the built-in regeneration resistor in the M3 EtherCAT series servo drive are as follows:

Drive P/N	Built-in Resistor		External Resistor
	Resistor (Ω)	Power P_R(W)	Minimum Resistor (Ω)
M3DV-21A8EC◆	200	40	40
M3DV-23A0EC◆	200	40	40
M3DV-24A5EC◆	100	60	40

◆Motor Type

4.8.1 Calculation method of regenerative energy

A. Reciprocating motion

When the motor decelerates, the kinetic energy during deceleration will be converted into electrical energy and fed back to the bus capacitor.

The energy during deceleration is divided into two parts:

A) Energy generated when the motor decelerates

B) Energy generated when the external load decelerates

The following provides a simple method to simply calculate the required regenerative energy absorption resistance.

1) Calculate the energy EM when the motor is decelerating

The following table shows the energy produced when the M3 series servo motor decelerates from 3000 rpm to 0 rpm without external load.

Motor Series	Power (W)	Motor P/N	Rotor Inertia J_M(10^{-4}Kg·m²)	Energy produced by decelerating	Maximum energy absorbed by the driver capacitor E_C(J)
Low Inertia	50	SM3L-041A****	0.0232	0.11	8.69
	100	SM3L-042A****	0.043	0.21	8.69
	200	SM3L-061A****	0.152	0.75	8.69
	400	SM3L-062A****	0.243	1.20	13.04
	750	SM3L-083A****	0.856	4.22	26.57
Medium Inertia	400	SM3M-062A****	0.655	3.23	8.69
	750	SM3M-083A****	1.37	6.75	13.04
High Inertia	850	SM3H-132A****	13.9	68.52	40.57
	1300	SM3H-133A****	19.4	95.64	40.57
	1800	SM3H-134A****	23.3	114.86	40.57

2) Calculate the energy EL generated by the dragged load during deceleration.
Assuming that the inertia of the load is N times the inertia of the motor, the energy generated when the dragged load is decelerated from 3000rpm to 0rpm is:

$$E_L=N \times E_M$$

If EM+EL <EC, that means during deceleration, the energy generated by the motor and the dragged load during deceleration is less than the energy that the drive capacitor can absorb, so there is no need to worry about regenerative energy absorption.

3) Calculate the average power PAV of the required regenerative energy absorption resistance

$$P_{AV} = \frac{E_M + E_L - E_C}{t_{dec}}$$

t_{dec} is the deceleration time + the interval time between two deceleration's

4) Judgement

If PAV < PR ，The total power generated during deceleration is less than the power of the built-in regenerative energy absorption resistance of the drive, so no external resistance is needed.

If PAV > PR ，The total power generated during deceleration is greater than the power of the built-in regenerative resistance of the drive, and an external resistance is required. In order to reasonably control the temperature rise of the external absorption resistance, the minimum resistance power is PAV / 0.5.

For example：

Use 400W motor SM3L-062A****，The load inertia is 15 times the motor inertia. Assuming tdec (deceleration time + interval between two deceleration's) is 0.5s, and each movement is decelerated from 3000rpm to 0rpm, the required power of the regeneration resistance is calculated as:：

E_M = 1.2J, E_C = 13.04J
E_L = N x E_M = 15 x 1.2 = 18J
P_{AV}=(1.2+18-13.04) / 0.5 = 12.32Watt

Since the 400W driver has a built-in absorption resistor power of 40W, there is no need to connect an external resistor.

B. The external load torque drives the motor, and most of the continuous negative power output of the motor is doing positive work, that is, the torque output direction of the motor as same as the direction of rotation. In some special applications, the torque output direction of the motor just opposite to the speed direction, and the external energy will be fed back into the drive at this time. The servo system will output the opposite force to overcome the gravity of the external load in order to meet the requirements of position and speed. Such as the vertical downward movement of a large load, when running for a long time, the bus capacitance is full and it cannot continue to absorb the regenerative energy. At this time, the regenerative resistor is required to absorb the energy. The power calculation formula is as follows:

$$P_T = 2\pi T_M N_M$$

Where:
    M is the output torque，Unit: Nm
    M is the speed，Unit: rps

For example ：
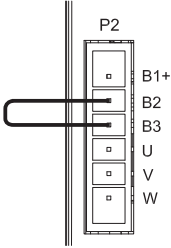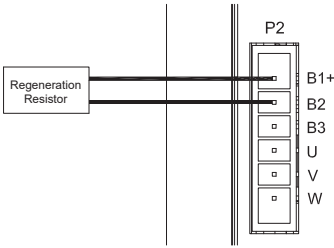
The torque output direction of the motor is opposite to the direction of rotation. When the motor output torque is 0.6Nm and the speed is 2400rpm, the power at this time is:

PT=2 x 3.14 x 0.6 x 2400 / 60= 150.72

At this time, an external absorption resistor is required, and the minimum power is 150.72W. In order to reasonably control the temperature rise of the external absorption resistor, the minimum power is 300W.

4.8.2 Regeneration Resistor Connection

In some applications, when the internal resistor cannot meet the absorption of the regenerative electromotive force, in order to prevent the driver from causing an over voltage alarm, an external resistor with a larger power is required; the wiring method of the resistor is as follows:

Using built-in resister	Using external resistor
Please short-circuit the B2 and B3 of the P2 connector. Note: The short-circuit has been installed at the factory	Please connect the resistor to B1+ and B2, and keep B2 and B3 disconnected

4.8.3 Drive Parameter Setting

The parameters are as follows：

Parameter	Item	Unit	Description
P1-19	Resistor Value	Ohm	Set the value of the regeneration resistor
P1-20	Resistor Power	Watt	Set the power of the regeneration resistor
P1-21	Regeneration absorption time constant	ms	Set the sustainable absorption time of the regeneration resistor

Note:

Please set the resistor value, power and absorption time of the absorption resistor correctly, otherwise it will affect the use of this function and cause the drive to give alarms such as over voltage and failure of regenerative energy absorption.

When connecting an external resistor, make sure that the total resistance value cannot be less than the minimum allowable resistance value of the drive. If multiple resistor series and parallel connections are used, please calculate the total resistance and total power correctly.

External：100Ω，200W	Parameter set: P1-19 = 100 P1-20 = 200
External：2*50Ω200W, in serial	Parameter set: P1-19 = 100 P1-20 = 400
External：2*100Ω200W, in parallel	Parameter set: P1-19 = 50 P1-20 = 400

4.9 Connect to Host Computer, CN1

Port CN1 is used to connect drive with PC. Use Luna software to set control mode, change parameter values, use auto-tuning function and so on.

Pin No.	Symbol	Function
1	+5V	USB Power 5V
2	D-	USB Data-
3	D+	USB Data+
4	--	——
5	GND	USB GND

Note: Please use USB Mini-B for the driver side connector

4.10 Input and Output Signal Interface Connector, CN2

4.10.1 Input and Output Interface Specifications and Diagram

The CN2 port of M3 EtherCAT series AC servo drive is used to connect input and output signals. The pin definition is as follows:

Function Type：F type、R type
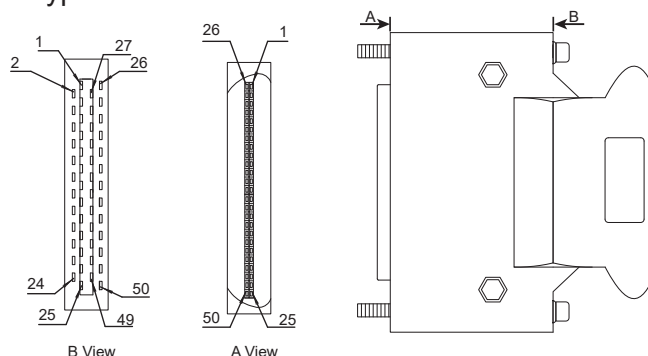
Function Type：X type、N type
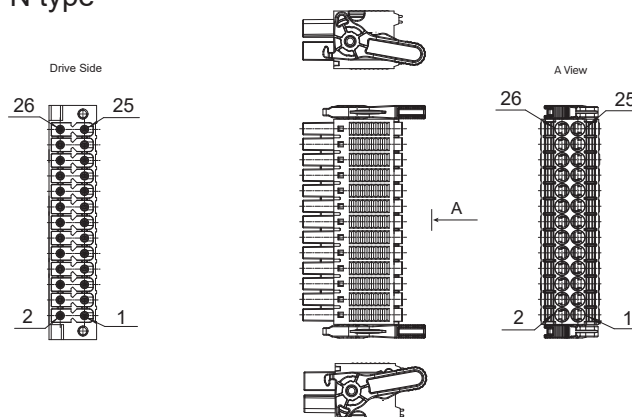
Input and output specification:

I/O	Digital Signal	Inputs	8 Configurable Optically isolate general Inputs, 24VDC, 20mA
		Outputs	4 Configurable Optically isolate general Outputs, max 30VDC, 20mA .
	Analog Signal	Inputs	2 analog inputs, -10V~+10V, resolution 12bit (F-type and X-type only)
		Outputs	1 analog outputs, -10V~+10V, maximum 10mA (F-type and X-type only)

■ I/O Diagram

Function Type：F type、R type
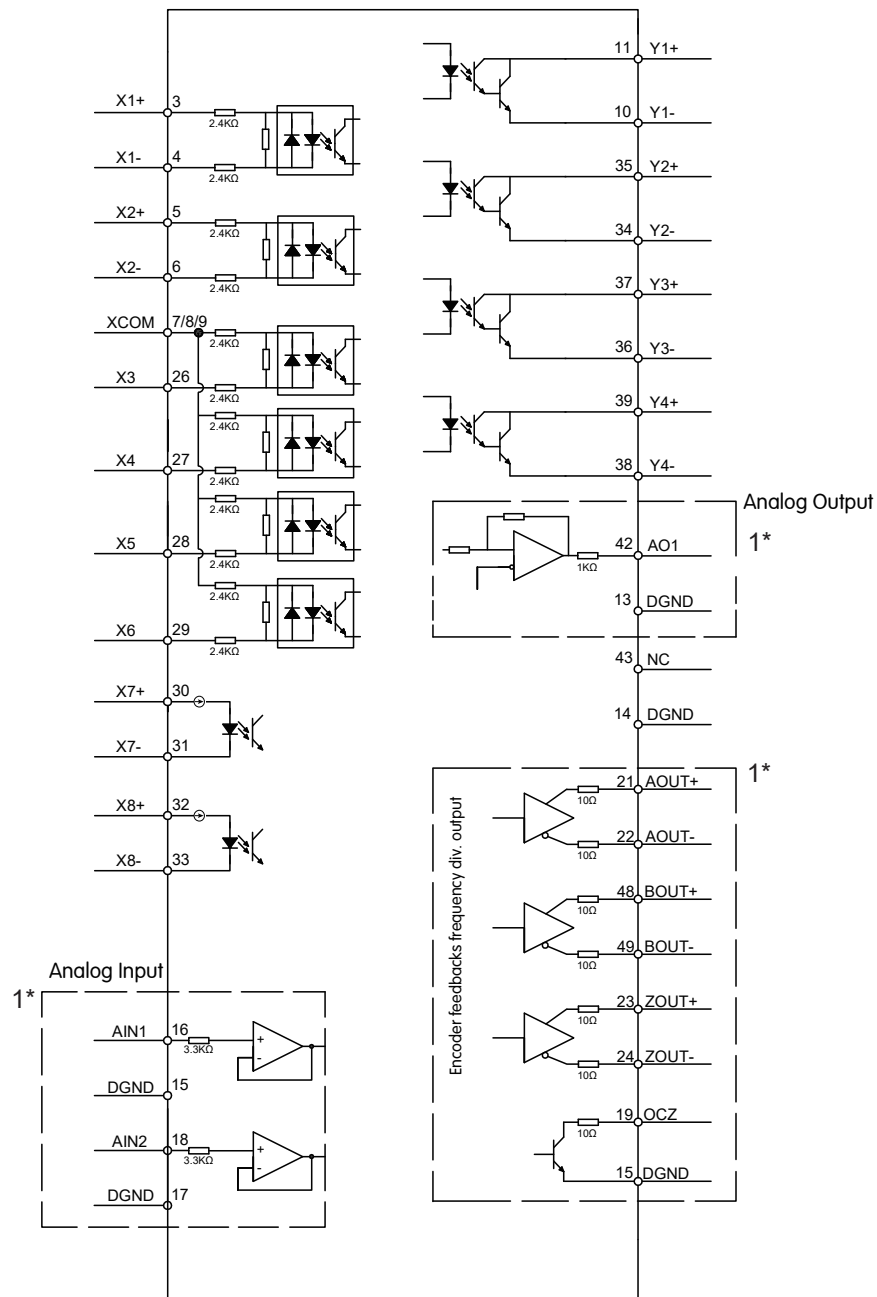
1*: The curve box is only applicable to F-type drives

Note: Do not make any connections to undefined pins

Function Type：X type、N type
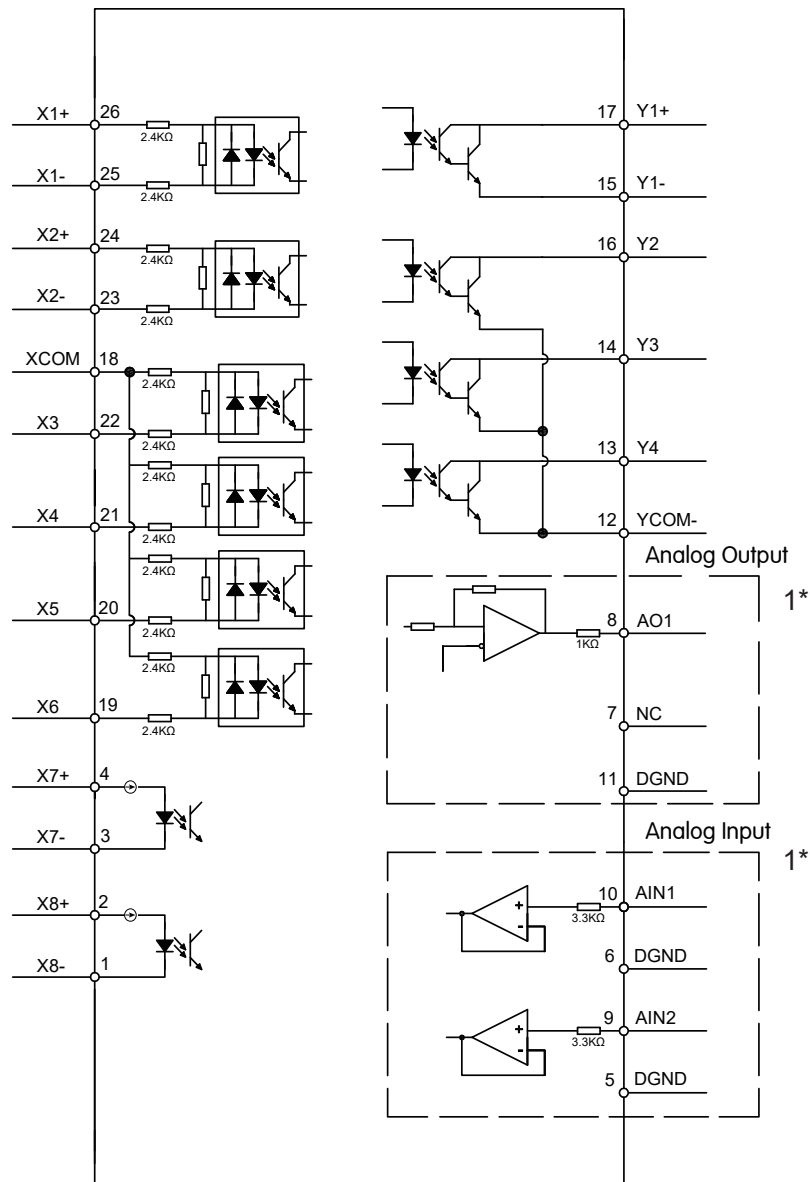
1*: The curve box is only applicable to F-type drives

Note: Do not make any connections to undefined pins

4.10.2 Input and Output Pin Definition

F-type、R-type

PIN No.	Symbol	Description	PIN No.	Symbol	Description	PIN No.	Symbol	Description
1	--	--	18	AIN2	Analog Input 2	35	Y2+	Digital Output 2+
2	--	--	19	OCZ	Encoder Index open collector Output	36	Y3-	Digital Output 3-
3	X1+	Digital Input 1+	20	--	--	37	Y3+	Digital Output 3+
4	X1-	Digital Input 1-	21	AOUT+	Encoder Output A+	38	Y4-	Digital Output 4-
5	X2+	Digital Input 2+	22	AOUT-	Encoder Output A-	39	Y4+	Digital Output 4+
6	X2-	Digital Input 2-	23	ZOUT+	Encoder Output Z+	40	--	--
7	XCOM	Digital Input Common	24	ZOUT-	Encoder Output Z-	41	--	--
8			25	DGND	Digital GND	42	AO1	Analog Output 1
9			26	X3	Digital Input 3	43	NC	Reserved
10	Y1-	Digital Output 1-	27	X4	Digital Input 4	44	--	--
11	Y1+	Digital Output 1+	28	X5	Digital Input 5	45	--	--
12	--	--	29	X6	Digital Input 6	46	--	--
13	DGND	Digital GND	30	X7+	Digital Input 7+	47	--	--
14			31	X7-	Digital Input 7-	48	BOUT+	Encoder Output B+
15			32	X8+	Digital Input 8+	49	BOUT-	Encoder Output B-
16	AIN1	Analog Input 1	33	X8-	Digital Input 8-	50	--	--
17	DGND	Digital GND	34	Y2-	Digital Output 2-	--	--	--

X-type、N-type

PIN No.	Symbol	Description	PIN No.	Symbol	Description
25	X1-	Digital Input 1-	26	X1+	Digital Input 1+
23	X2-	Digital Input 2-	24	X2+	Digital Input 2+
21	X4	Digital Input 4	22	X3	Digital Input 3
19	X6	Digital Input 6	20	X5	Digital Input 5
17	Y1+	Digital Output 1+	18	XCOM	Digital Input Common
15	Y1-	Digital Output 1-	16	Y2	Digital Output 2
13	Y4	Digital Output 4	14	Y3	Digital Output 3
11	DGND	Digital GND	12	YCOM-	Digital Output Common
9	AIN2	Analog Input 2	10	AIN1	Analog Input 1
7	NC	Reserved	8	AO1	Analog Output 1
5	DGND	Digital GND	6	DGND	Digital GND
3	X7-	Digital Input 7-	4	X7+	Digital Input 7+
1	X8-	Digital Input 8-	2	X8+	Digital Input 8+

Note: Do not make any connections to undefined pins

4.10.3 Digital Input Signal

The M3 EtherCAT series AC servo drive has 8 digital input signals, and each input signal can be configured to a specific function through parameters as well as the logic of the input level. In the M3 EtherCAT series AC servo, each pin has the following functions:

◆ **Specific function signals,** such as alarm reset, limitation switch, Touch Probe signal input, etc.
◆ **General input signal,** as a general input signal, no specific function
■ List of assignable function inputs

Function	Symbol	Function Code	
		Closed	Open
General Input	GPIN	0	
Alarm Reset	A-CLR	3	4
CW Limit	CW-LMT	5	6
CCW Limit	CCW-LMT	7	8
Gain Select	GAIN-SEL	11	12
Emergency Stop	E-STOP	13	14
Torque Limit Input	TQ-LMT	19	20
Zero speed Clamp	ZCLAMP	21	22
Velocity Limit Input	V-LMT	37	38
Homing Sensor Switch	HOM-SW	39	40
Virtual-CW-LMT	Virtual-CW-LMT	41	42
Virtual-CCW-LMT	Virtual-CCW-LMT	43	44

F-type, R-type

Signal	Symbol	CN2-PIN No.	Default	
			Function	Input Logic[1]
X1	X1+	3	Virtual-CCW-LMT	Open
	X1-	4		
X2	X2+	5	Virtual-CW-LMT	Open
	X2-	6		
X3	X3	26	Alarm Reset	
X4	X4	27	General purpose Input	Closed
X5	X5	28	Emergency Stop	Closed
X6	X6	29	Torque Limit Input	Closed
XCOM	XCOM	7		
X7	X7+	30	Touch Probe 1	Closed
	X7-	31		
X8	X8+	32	Homing Switch	Closed
	X8-	33		

X-type, N-type

Signal	Symbol	CN2-PIN No.	Default	
			Function	Input Logic*1
X1	X1+	26	Virtual-CCW-LMT	Open
	X1-	25		
X2	X2+	24	Virtual-CW-LMT	Open
	X2-	23		
X3	X3	22	Alarm Reset	
X4	X4	21	General purpose Input	Closed
X5	X5	20	Emergency Stop	Closed
X6	X6	19	Torque Limit Input	Closed
XCOM	XCOM	18		
X7	X7+	4	Touch Probe 1	Closed
	X7-	3		
X8	X8+	2	Homing Switch	Closed
	X8-	1		

Note: The level logic of the pin input is as follows:

Closed: The drive's digital input circuit forms a loop, and current flows in or out of the input pin

Open: The drive's digital input circuit does not form a loop, and there is no current flowing in or out of the input pin

4.10.4 Digital Output Signal

The M3 EtherCAT series AC servo drive has 4 digital output signals. Each output signal can be configured to a specific function through parameters as well as the logic of the output level.

■ List of assignable function outputs

Function	Symbol	Function Code	
		Closed	Open
General purpose Output	GPOUT	0	
Alarm Output	ALM	1	2
Warning Output	WARN	3	4
Brake Release Output	BRK	5	6
Servo on Status	SON-ST	7	8
Positioning Complete	COIN	9	10
Dynamic Pos. Output	DYM-LMT	11	12
Torque Reach Output	TQ-REACH	13	14
Torque Limit Output	T-LMT	15	16
Velocity Coincidence Output	V-COIN	17	18
Velocity Reach Output	AT-SPD	19	20
Velocity Limit Output	V-LMT	21	22
Servo Ready	S-RDY	23	24
Homing Finished	HOMED	25	26
Soft Limit CW	SLCW	27	28
Soft Limit CCW	SLCCW	29	30
Near Target Position Output	IN-POS	31	32
Zero speed detected Output	Z-SPD	33	34
Torque Coincidence Output	T-COIN	35	36

F-type, R-type

Signal	Symbol	CN2-PIN No.	Default	
			Function	Input Logic*1
Y1	Y1+	11	General purpose Output	Open
	Y1-	10		
Y2	Y2+	35	Servo Ready	Closed
	Y2-	34		
Y3	Y3+	37	Alarm Output	Open
	Y3-	36		
Y4	Y4+	39	Positioning Complete	Closed
	Y4-	38		

X-type, N-type

Signal	Symbol	CN2-PIN No.	Default	
			Function	Input Logic*1
Y1	Y1+	17	General purpose Output	Open
	Y1-	15		
Y2	Y2	16	Servo Ready	Closed
Y3	Y3	14	Alarm Output	Open
Y4	Y4	13	Positioning Complete	Closed
YCOM-	YCOM-	12	Y2~Y4 Output Common	———

Note: The level logic of the pin input is as follows:

Closed: The drive's digital input circuit forms a loop, and current flows in or out of the input pin

Open: The drive's digital input circuit does not form a loop, and there is no current flowing in or out of the input pin

4.10.5 Input Signal Wiring

■ Input X1、X2、X7、X8

M3 EtherCAT series AC servo drive has 4 optically isolated differential, 24VDC, maximum current 20mA digital input ports; X1 and X2 are ordinary input ports, X7 and X8 are high-speed input ports, and the high-speed input frequency can reach 2MHz. It can be used as a general input to connect sensor signals, Touch Probe 1 (X7) signals, Touch Probe 2 (X8) signals, PLC and other output signals of other controllers.

■ X1、X2、X7、X8 Circuits are as follows:
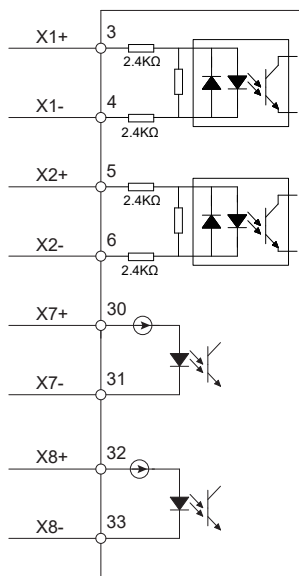
Function Type：F-Type、R-Type
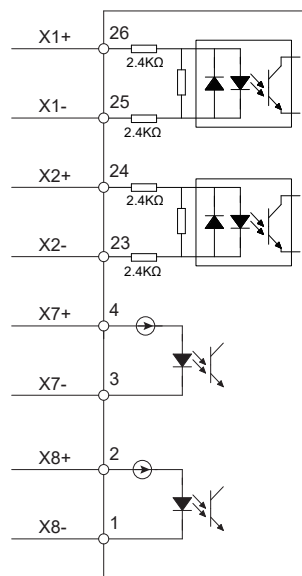
Function Type：X-Type、N-Type

■ X1、X2、X7、X8 Input connection Diagram

A. Host SINK Mode	B. Host SOURCING Mode
C. PNP Sensor Connection	D. NPN Sensor Connection
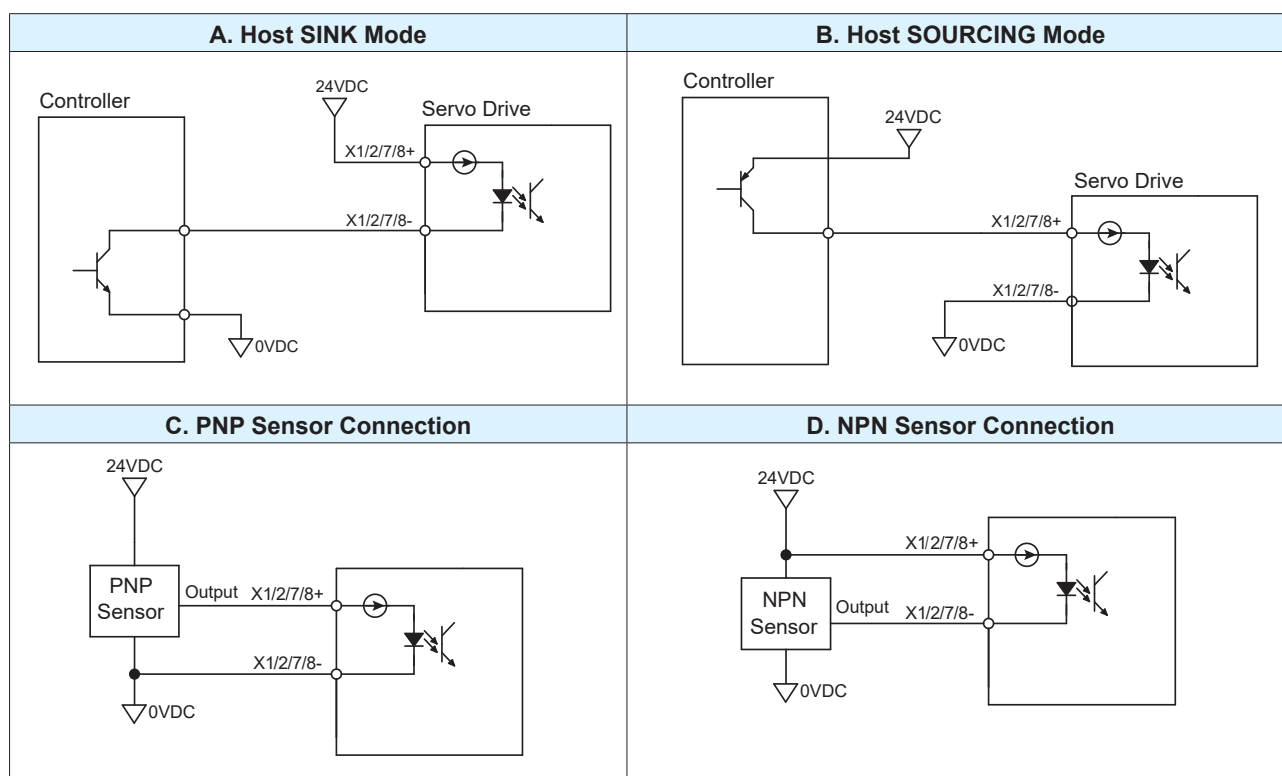
E. Sensor and Switch Connection	
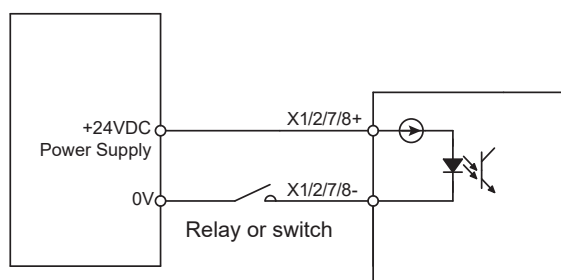
■ Input X3、X4、X5、X6

The M3 EtherCAT series AC servo also has 4 optocoupler isolated single-ended input ports with a common COM point. Because these input circuits are optically isolated, they require a power supply. If it is connected to a PLC, you can use the power supply of the PLC; if it is connected to a relay or a mechanical switch, a 24VDC power supply is required.

■ What's COM?

"Common" represents a common terminal of equal potential. If you are using a source current (PNP) signal, you should connect COM to the ground (negative power supply); if you are using a current sink (NPN) signal, then COM should be connected to the positive power supply.

■ X3、X4、X5、X6 Circuits are as follows:
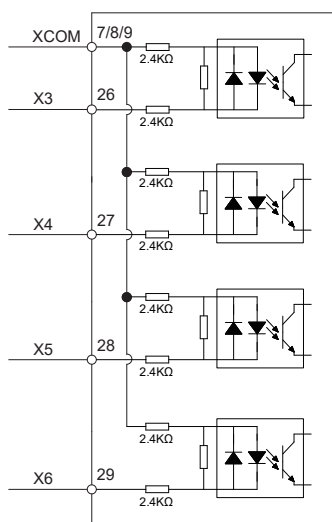
Function Type：F-Type、R-Type
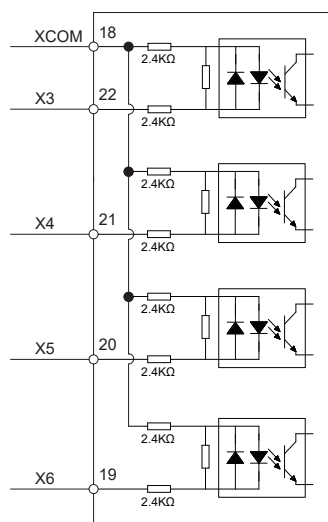
Function Type：X-Type、N-Type

■ X3、X4、X5、X6 Input connection Diagram

A. Host SINK Mode	B. Host Sourcing Mode
C. PNP Sensor Connection	**D. NPN Sensor Connection**
E. Sensor and Switch Connection(XCOM to Power supply)	**F. Sensor and Switch Connection(XCOM to GND)**
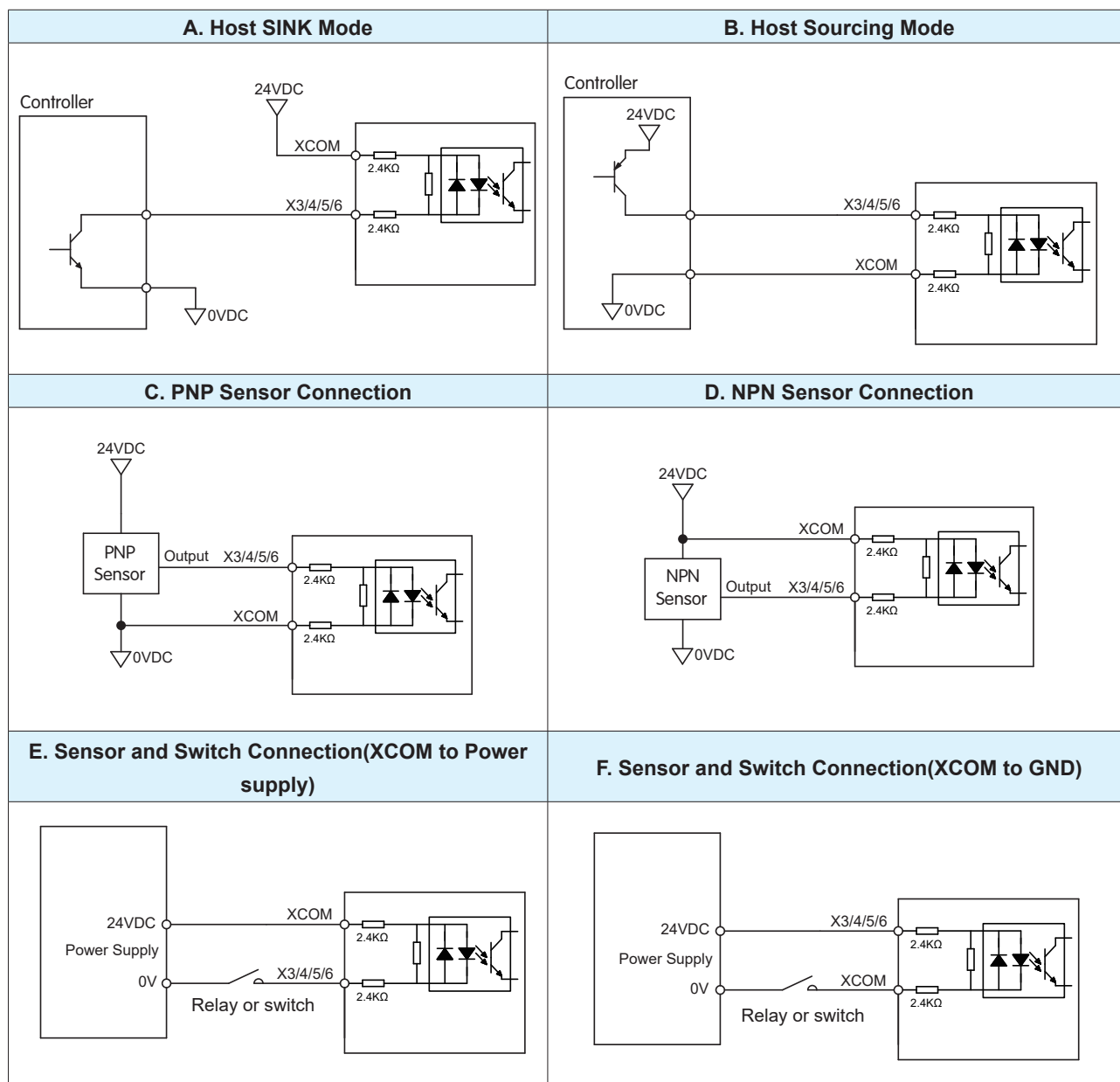
4.10.6 Analog Signal Input

The F-type and X-type drives have 2 single-ended analog inputs. The voltage range is -10V~+10V and the speed and torque range can be set by parameters.

Signal		CN2-Pin No.		Description
		F-type	X-type	
AIN1	Analog Input Signal	16	10	In the analog speed mode, the analog speed command can be configured to change the setting range.
AIN2		18	9	In the analog torque mode, the analog torque command can be configured to change the set range 100% corresponds to 1 times the rated torque output of the motor.
DGND		15，17	5，6	Reference ground for analog input signal

■ Analog Input connection Diagram
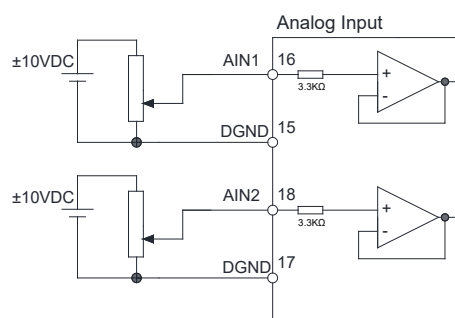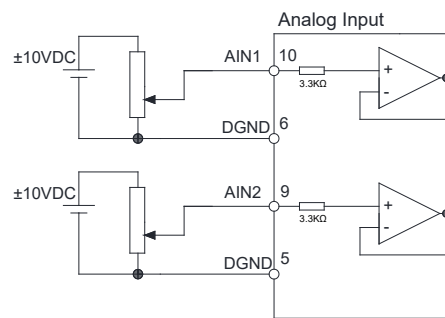
Function Type：F-Type   Function Type：X-Type

4.10.7 Output Signal Wiring

M3 EtherCAT series AC servo drives, the F-type and R-type have 4 optocoupler isolated differential digital outputs as well as the X-type and N-type have 1 optocoupler isolated differential output and 3 optocoupler isolated outputs with COM. The functions can be configured through software while the connection of SINK and SOURCING is supported.

■ Output Signal Diagram
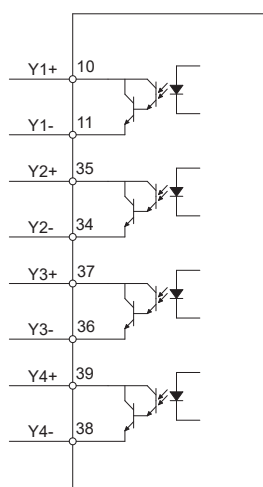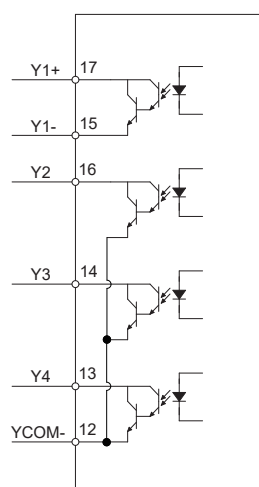
Function Type：F-Type、R-Type   Function Type：X-Type、N-Type

■ Output Connection Diagram

F-type, R-type

A. Optocoupler Circuity	B. Connect to External Load

C.Connect to Relay Circuity	

X-type, N-type

A. Optocoupler Circuity	B. Connect to External Load

C.Connect to Relay Circuity	
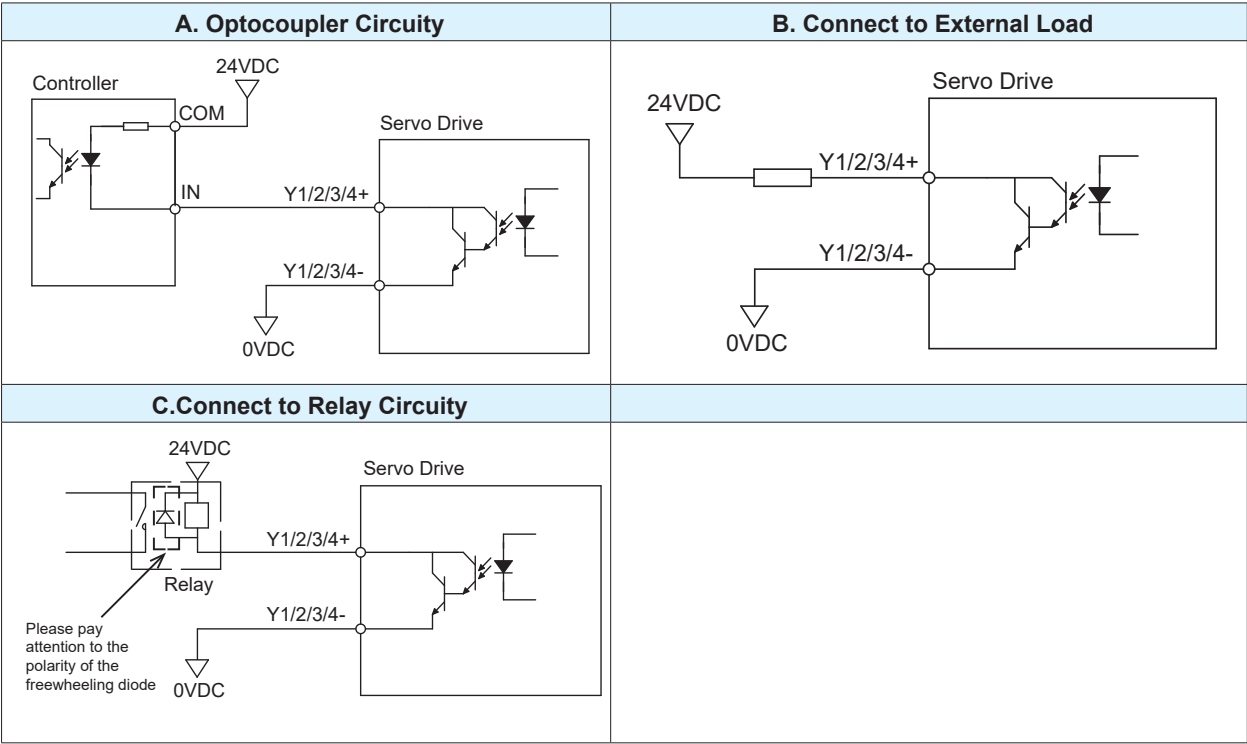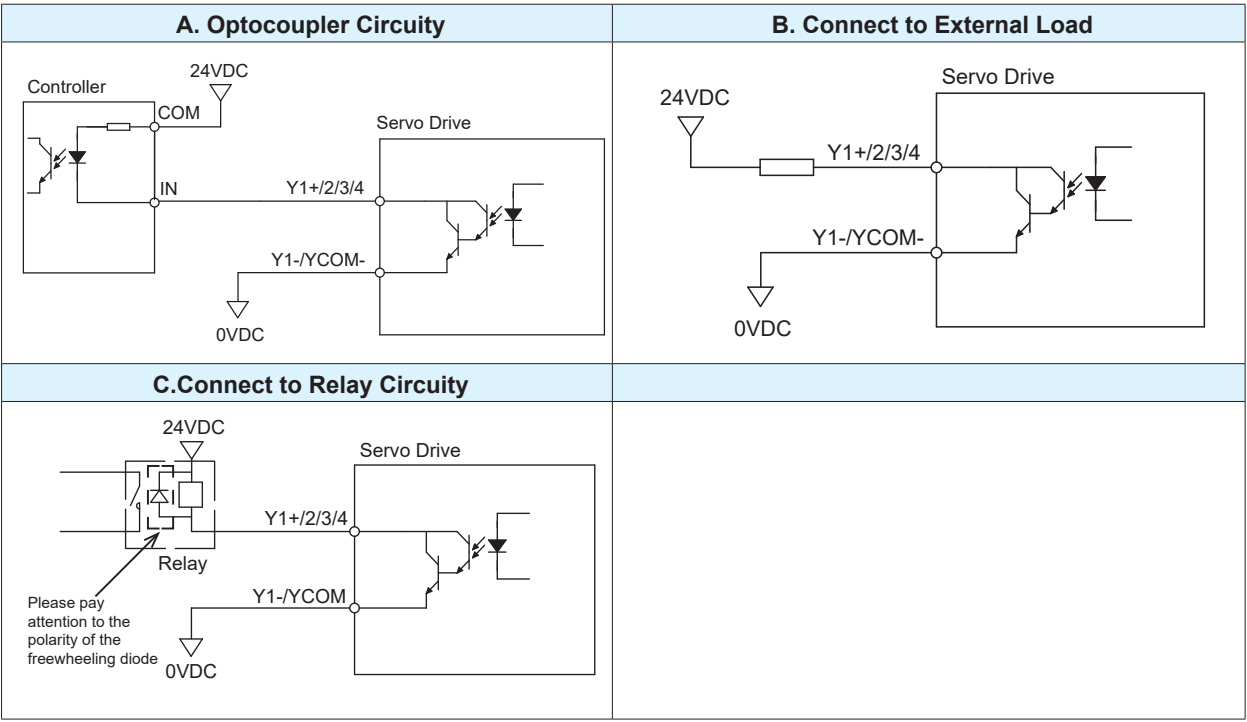
Note: Maximum output current is 30VDC 30mA.

4.10.8 Encoder Feedback Output

M2 series AC servo drive can output encoder A/B/Z phase as differential output signals through line driver.

The output signal is 5V.

The host must use line receiver to receive the signals. Please use twist pair wires for signal transfer.

CN2-Pin No.	Signal		Description
21	AOUT+	Encoder Signal Output	The feedback signal of the encoder is output in the form of A, B, Z differential, and the number of output pulses per rotation of the motor can be set through configuration.
22	AOUT-		
48	BOUT+		
49	BOUT-		
23	ZOUT+		
24	ZOUT-		
19	OCZ		Encoder Z signal opens collector output
15	DGND		DGND of OCZ output

■ A/B/Z Connection Diagram
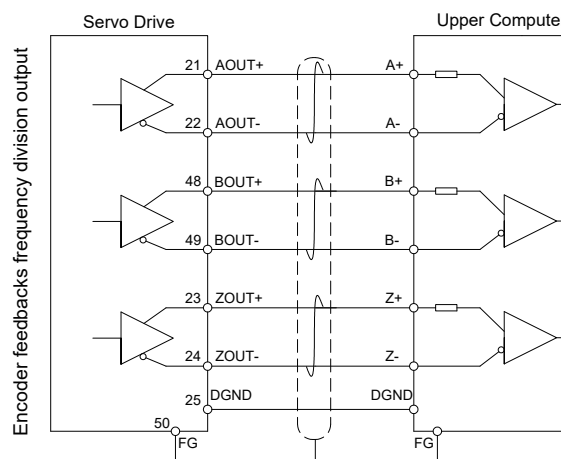
Note: Please make sure the host controller and the servo drive are connected to a common ground.

■ Z Phase Open Collector Output

In M3 series AC servo drive, encoder signal Z uses open collector output circuity. Due to the narrow bandwidth of encoder signal Z, please use high speed optocoulper circuity for the host receiver.

■ Z Open Collector Connection Diagram
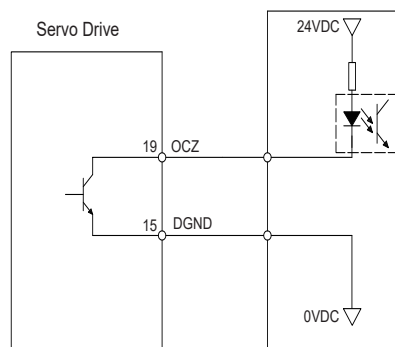
4.10.9 Analog Output Signal

F-type and X-type drives have a single-ended analog outputs to monitor the current percentage of motor current, percentage of command current, actual motor speed, motor command speed, position error and other data.

The output voltage range is -10V~+10V while the maximum output current is 10mA, and the output impedance is 10 Ω. Please pay attention to the input impedance of the external analog input circuit.

Signal		CN2-Pin No.		Description
		F-type	X-type	
AO1	Analog Signal Output	42	8	Use the analog output signal to monitor the operating parameters of the motor: actual current, command current, actual speed, command speed, position error The data corresponding to the two outputs can be set through configuration
DGND		13，14	11	DGND of analog output

■ Analog Output Signal Connection Diagram
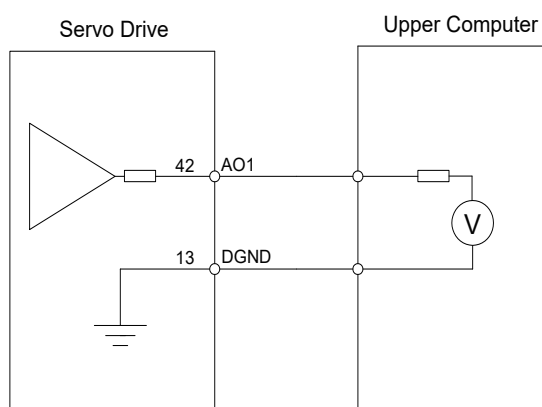
Motor Type: F Type
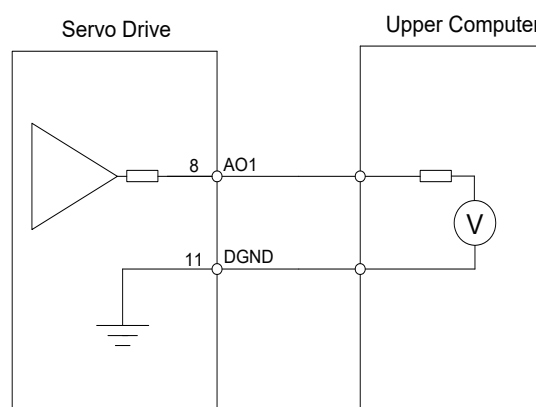
Motor Type: X Type

4.11 Full Closed loop Feedback Signal CN4

The CN4 connector is used to connect the A, B, Z differential signals of an encoder or grating ruler installed externally on the machine, for the servo drive to do full closed loop control.

■ Connector Definition

A View
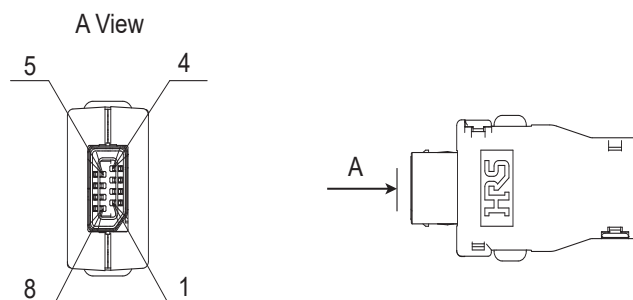
Item	Signal	CN4-Pin No.	Description
Power Supply	5V	1	Power supply for the second feedback signal
	GND	2	
Encoder Signal Input	Z-	3	Pulse type: differential Maximum frequency: 1Mpps Minimum pulse width: 0.5 μ s
	Z+	4	
	B-	5	
	B+	6	
	A-	7	
	A+	8	

■ Signal Connection Diagram
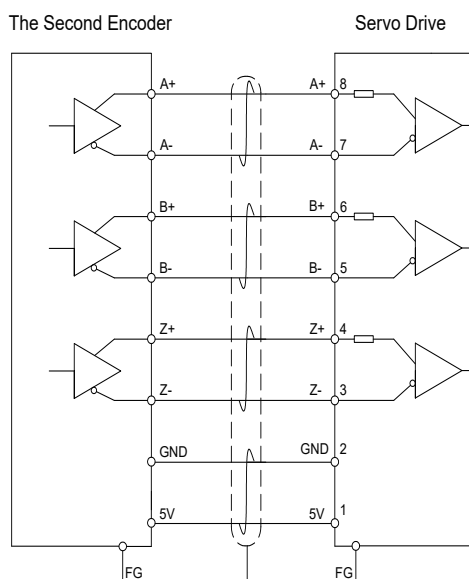
Precautions:

● Please use a twisted-pair shielded cable for the external second encoder signal wire, with a wire diameter of 0.18mm2AWG22 or more

● The total length of the cable is recommended to be within 10 meters. When the wiring is long, to prevent 5V voltage drop and signal attenuation, please increase the wire diameter

● To prevent interference, the digital ground of the external encoder must be connected to the one of the driver, and the cable shielding layer while the driver must be well grounded.

● The maximum 5V output current of the driver is 5V±5% 200mA Max. If the current consumption of the external encoder exceeds this specification, please use an external power supply.

● When using an external power supply, do not connect the external 5V to the 5V power output of CN4. However, the 0V of the external power supply must be connected to the 0V pin of CN4 of the driver to form an equipotential.

4.12 Safe Torque OFF(STO) CN5

In M3 EtherCAT AC servo series, the F-type and X-type drives support the safe torque off(STO) function.

The STO (Safe Torque Off) function is connected via port CN5. The STO function shuts off the motor current which will turn off output torque by forcibly turning off the signal of the servo driver power transistor. This is done internally through the STO Input/ Output signal circuit.

After the STO function is triggered, the drive will have a fault alarm status(Alarm code: r20to), and the motor will be disabled.

4.12.1 Safety Precautions

● If do not use the STO function, make sure the STO connector is plugged into CN5 on the drive correctly.

● When using the STO function, perform an equipment risk assessment to ensure that the system conforms to the safety requirements.

● Even when the STO function is enabled, the servo motor may move due to external force (e.g. gravitational force on the vertical axis). Make sure a holding brake is used in applications where this is possible.

● When the STO function engages and removes the torque, the motor will be "free running", requiring more distance until the motion stops. Make sure this will not be a safety issue.

● When the STO function operates, it will turn off the current to the motor, but it does not turn off the power to the servo drive. Make sure to disconnect the power to the drive before performing any maintenance on it.

● After the STO function is triggered, the drive will have a fault alarm status, and the motor will be disabled.

● After the STO signal return to normal, the drive will automatically clear the STO fault alarm, but the motor will remain disabled. To restore the system to normal operation, re-enable is needed.

4.12.2 STO Input/Output Signals

■ Internal Circuit Diagram
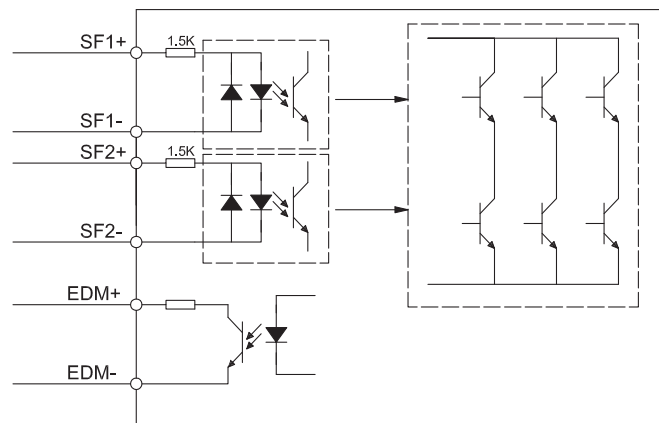
■ Input/Output Pin No.
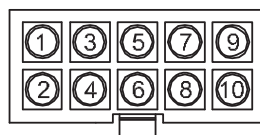
■ STO Signal Definition

Signal	Symbol	Pin	Description	Control Mode
Safety Input SF1	SF1+	1	When SF1 has no input signal, e.g. the port is disconnected, SF1 will be considered OFF. The upper half of the internal power transistor will be shut off.	Compatible with all control mode
	SF1-	5		
Safety Input SF2	SF2+	3	When SF2 has no input signal, e.g. the port is disconnected, SF2 will be considered OFF. The upper half of the internal power transistor will be shut off.	
	SF2-	2		
Safety Output	EDM+	6	Output monitor signal used to check the safety function.	
	EDM-	4		
Ground	DGND	7，8	+5VDC power ground	
+5V Power	+5V	9，10	+5VDC power supply	

Note: When any of the safety inputs SF1 and SF2 are OFF, the STO function will start to work.

■ STO Connection Diagrams

● Connection to safety switch
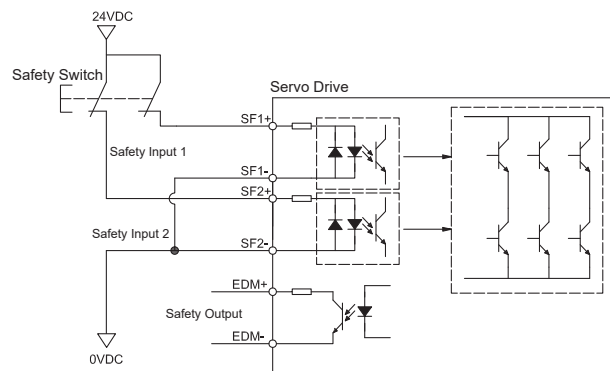
● Safety light curtain connection
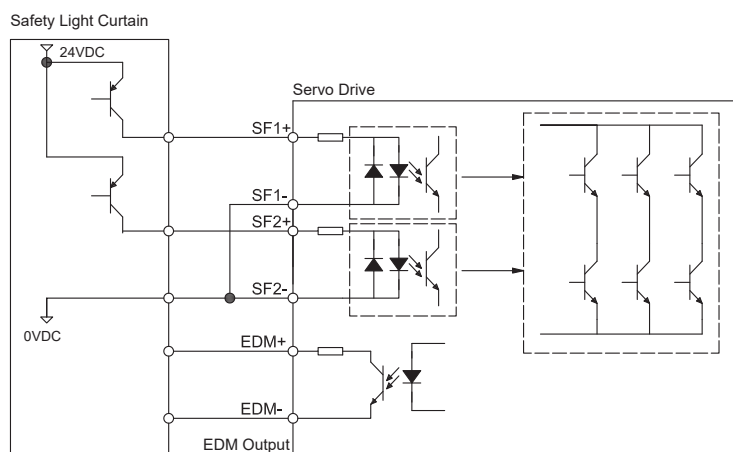
5 Display and Operation

5.1 Description of Control Panel

Symbol	Name	Details
	LED Display	The LCD display (5 digits, 7 segments) shows the drive's operating condition, warning codes, parameters, and setting values.
(M)	MODE	Press and hold MODE button to switch the LED display mode a) Monitoring selection mode b) Function selection mode c) Parameter setting mode When editing the parameters, press the MODE button to move the cursor to the left and then change the parameters by using the UP/DOWN buttons.
(▲) (▼)	UP/DOWN	Press the UP and DOWN buttons to scroll through and change monitor codes, parameter groups and other parameter settings.
(S)	SET	Press to enter a mode Press and hold to save parameters/settings

5.2 Switch of Mode

- Pressing the MODE button and the SET button changes between status monitoring, function control, parameters setting and other modes.

- If no warnings or faults occur, the drive will not go into warning and fault display mode.

- If any warnings are detected by the drive, the LED display will switch into warning or fault display mode immediately. Pressing Mode/Set button will switch back to the previous display mode. Pressing UP/DOWN button will switch other warning or fault display.

- If no button(s) on the control panel is pressed for 20 seconds, the display will switch back to the previous status monitoring display mode.

- In monitoring selection mode, function selection mode and parameter setting mode, to edit the values, press MODE to move the cursor to the left, then change parameters by using the UP/DOWN buttons.

- In status monitoring mode, press and hold the SET button to lock the control panel. To unlock the panel, press and hold the SET button again.

Control mode switch flowchart:
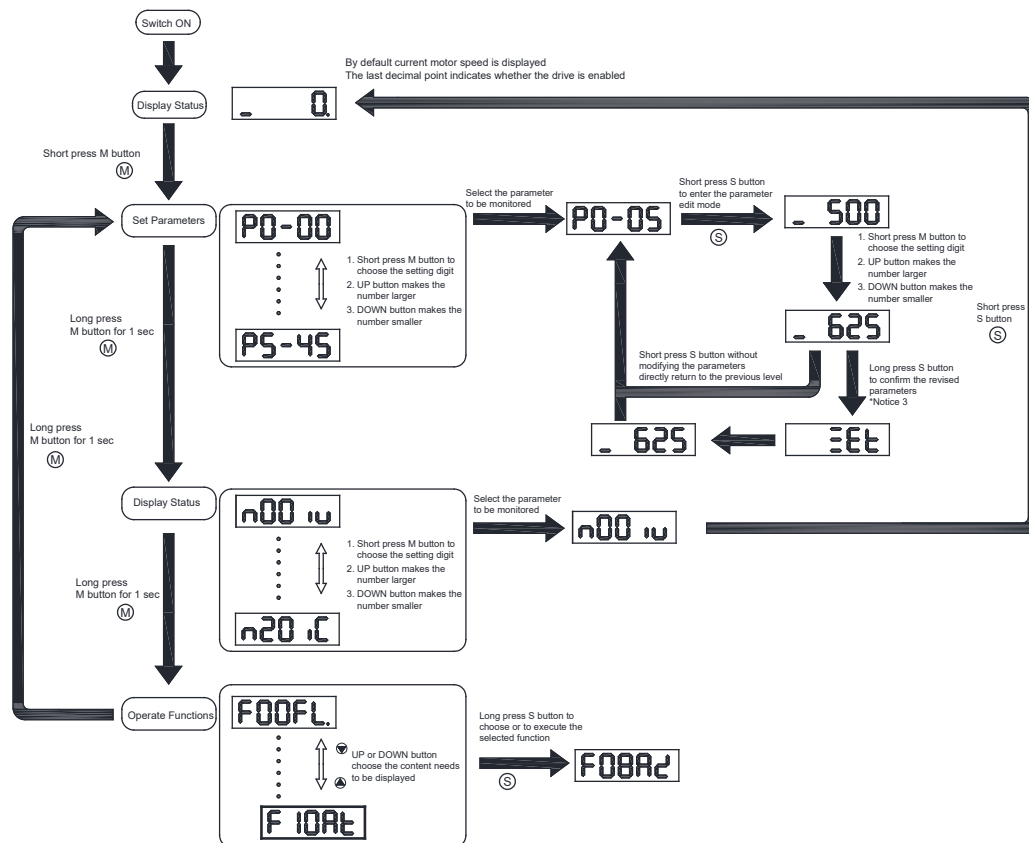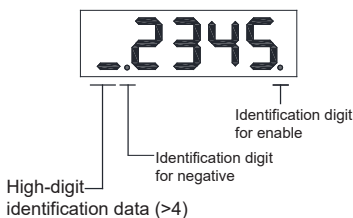
Caution:

(1) After power on, the status selected by the customer will be displayed. By default, the current motor speed is displayed.

(2) In the parameter setting mode, short press SET button will exit the parameter edit mode and return to parameter setting selection interface without saving any settings.

(3) In parameter setting mode, long press SET button will confirm the modification of the parameter, which will take effect immediately without saving in drive flash. If it is needed to save the parameter after power failure, it is recommended to choose parameter saving function in the function operation interface which long press SET button will take effect.

(4) Do not save parameters when the motor is running.
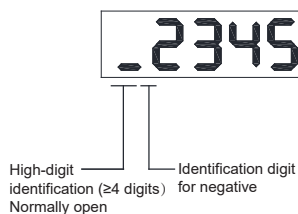
5.3 LED display description

5.3.1 Decimal Point And Negative Sign Description
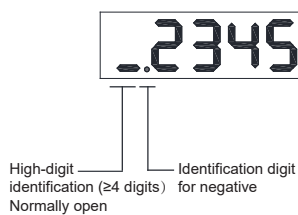
LED display	Description
_.2345. Identification digit for enable Identification digit for negative High-digit identification data (>4)	◆ Enable Identification Digit: The decimal point at the lower corner of the LED panel is the identification digit to judge whether the drive is enabled. If it is on, it means the drive is enabled and the motor is powered on. If it is off, it means the drive is not enabled and the motor is not powered on. ◆ Negative identification digit: It represents whether the number shown is positive or not. ON: negative OFF: positive ◆ High-digit data (>4): when the displayed data is greater than 4 digits, it will be displayed in pages and the identification digit will mark the number of digits at this time. For details, please refer to 5.3.2 "display with more than 4 digits"

5.3.2 Data Display

■ Positive Display (≤4 digits)

LED display	Description
_.2345 High-digit identification (≥4 digits) Normally open Identification digit for negative	◆ The first digit from the left is the identification digit of more than 4. When it is at the bottom of 7-terminal LED, it means the display is low 4-digit data. Always on: it means the displayed data is the lower 4-digit data and there is no higher data. Flashing: It represents the displayed data is the lower 4-digit data and there exists numbers greater than 4 digits. ◆ When the decimal point of negative identification digit is off, it means the displayed data is positive. **As shown in the figure, the displayed number is 2345.**
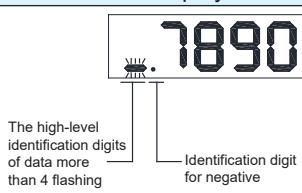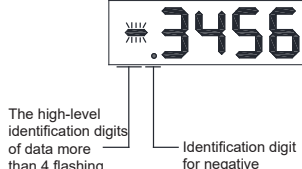
■ Negative Display(≤4 digits)
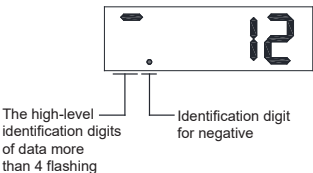
LED display	Description
_.2345 High-digit identification (≥4 digits) Normally open Identification digit for negative	◆ The first digit from the left is the identification digit of more than 4. When it is at the bottom of 7-terminal LED, it means the display is low 4-digit data. Always on: it means the displayed data is the lower 4-digit data and there is no higher data. Flashing: It represents the displayed data is the lower 4-digit data and there exists numbers greater than 4 digits. ◆ When the decimal point of negative identification digit is on, it means the displayed data is negative. **As shown in the figure, the displayed number is -2345.**

■ Number display (≥5 digits)

Since M3 series AC Servo LED display panel has only 5 digits, when it is necessary to display data greater than 5 bits, the following method is adopted.

e.g. If we want to display -1234567890

	LED display	Description
Display "7890" in the lower 4 bits	7890 The high-level identification digits of data more than 4 flashing Identification digit for negative	◆ The first digit from the left is the identification digit of data more than 4. When it is at the bottom of the 7-terminal LED, it represents the display the lower 4 digits of data have been shown. Flashing: it means that the displayed data is lower 4 digits and there are more than 4 digits. ◆ When the decimal point of negative number identification digit is always on, it means the displayed data is negative.
Display "3456" in the middle 4 digits	.3456 The high-level identification digits of data more than 4 flashing Identification digit for negative	◆ The first digit from left lights up in the middle of the 7-terminal LED, indicating that the data in the middle 4 digits is displayed. Always on: it represents the middle 4-digit data as displayed one and there is no higher data. Flashing: it represents the middle 4-digit data as displayed one and there are higher digits.

Display "12" as the highest digits	The high-level identification digits of data more than 4 flashing / Identification digit for negative	◆ The first digit from the left lights up on the upper part of the 7-terminal led, which means the highest 4 digits of data are displayed. Always on: it means the displayed data is the highest 4-digit data and there is no higher data.

When the high-level identification digit flashes, it represents there are numbers in high-digits and short press on " ▲ " / " ▼ " can switch the number of pages displayed.

5.3.3 Other Display Data

LED display	Description
SEt	It means ″SET". When modifying the parameter, long press "S" button for 1s. When the parameter is modified successfully, it takes effect immediately. It will not be saved when power failure happens.
SAuEd	In parameter setting mode, pressing and holding the "S" button will save the change. 'Saved' will also be displayed on the LED.
buSY	In parameter setting mode when the motor is rotating and the is pressed and held, the LED display will read "busy" meaning that the current parameter change cannot be saved. Stop the current motor motion and save the parameter again.

5.3.4 Point To Point Motion Mode

LED display	Description
P--CW	When the LED display reads "P-CW" it means the motor is rotating in a CW direction in the point-to-point mode.
P-CCW	When the LED display reads "P-CCW" it means the motor is rotating in a CCW direction in the point-to-point mode.

5.3.5 Jog Mode

LED display	Description
J--CW	When the LED display reads "J-CW" it means the motor is rotating in a CW direction in JOG mode.
J-CCW	When the LED display reads "J-CCW" it means the motor is rotating in a CCW direction in JOG mode.

5.3.6 Control Panel Lock

LED display	Description
LCK	This means the key panel is locked. Press and hold 'S' for 1 second while in status monitoring mode to lock.
unLCK	When the control panel is locked, press and hold "S" for 1 second to unlock it.

5.4 Status Monitoring Selection Mode
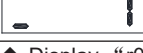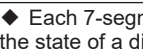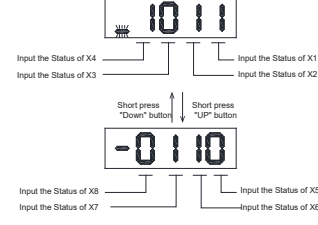
To change the status monitoring mode, press "M" to enter monitoring selection mode, and then use ⬆️⬇️ to make selections, and press "S" to confirm, as below:
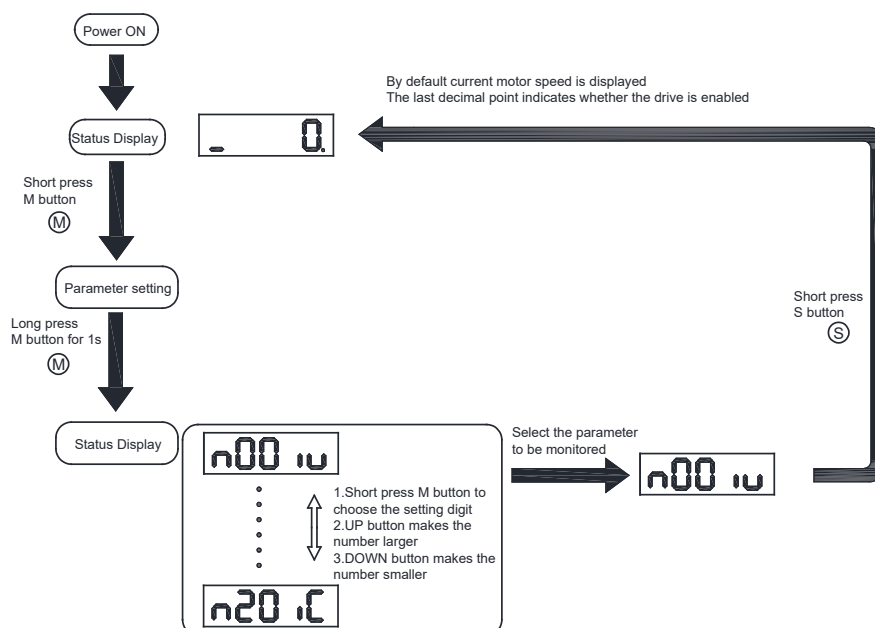
n-status display choose mode setting value	Display Symbols	Explanation	Unit	Display example
n-00	n00 ᵢᵤ	Actual motor speed	RPM Rotation per Minute	◆ Display when "3000" rpm ⎯3000. ◆ Display when "-3000" rpm ⎯.3000.
n-01	n01 ᵢ↳	Real time position error of motor	Pulses	◆ Display -1234567890 ※.7890 Short press "down" button ↑ Short press "UP" button ※.3456 Short press "down" button ↑ Short press "UP" button ⎯.12
n-02	n02L	Command pulse input count	Pulses	
n-03	n03 ᵢE	Motor encoder location	Pulses	
n-04	n04 ᵢP	Command location	Pulses	
n-05	n05 ᵢt	Drive PCB temperature	0.1℃	◆ Display "62.5" ℃ ⎯625
n-06	n06 ᵢU	DC Bus Voltage	0.1V	◆ Display "315.7" VDC ⎯3157
n-07	n07dA	EtherCAT Communication Node Address		◆ Display address is "1" ⎯1001
n-08	n08AH	Alarm history 0		◆ Display "r07" as alarm code ⎯7
n-09	n09AH	Alarm history 1		◆ Display "r07" as alarm code ⎯7

| n-status display choose mode setting value	Display Symbols	Explanation	Unit	Display example
n-10	n 10AH	Aarm history 2		◆ Display "r07" as alarming code _ 7
n-11	n 11AH	Aarm history 3		◆ Display "r07" as alarming code _ 7
n-12	n 12AH	Aarm history 4		◆ Display "r07" as alarming code _ 7
n-13	n 13AH	Aarm history 5		◆ Display "r07" as alarming code _ 7
n-14	n 14AH	Aarm history 6		◆ Display "r07" as alarming code _ 7
n-15	n 15AH	Aarm history 7		◆ Display "r07" as alarming code _ 7
n-16	n 16 iA	Analog input 1 sampling voltage	mV	◆ Display "8.211" V _8211
n-17	n 17 iA	Analog input 2 sampling voltage	mV	◆ Display "8.707" V _8707
n-18	n 18 in	Digital input status		◆ Each 7-segment number represents the state of a digital input 1: Closed Status 0: Open 1011 Input the Status of X4 — Input the Status of X1 Input the Status of X3 — Input the Status of X2 Short press "Down" button ↕ Short press "UP" button -0110 Input the Status of X8 — Input the Status of X5 Input the Status of X7 — Input the Status of X6
n-19	n 19oU	Command current percentage		◆ Each 7-segment number represents the state of a digital output 1: Closed Status 0: Open _1011 Output Status of Y4 — Output Status of Y1 Output Status of Y3 — Output Status of Y2
n-20	n20 iC	Command current percentage	0.1%	◆ Display current command - 72.5% _ 725

Note:

Closed**:** The digital input/ output circuit of the drive forms a loop and the current flows in or out from the input/ output pin. The drive has an input/ output signal.

Open**:**   The drive digital input/ output circuit does not form a loop. No current flows in or out of the input/ output pin and the drive has no input/ output signal.

5.5 Function operation mode

In this mode, the user can select the function to be executed and display it with F+ parameter number. In the status display selection mode, long press (M) for 1s can enter the function operation mode and then we can choose to use ▲ ▼ the needed function. Finally, we can long press (S) to confirm or execute the selected function.

(Caution: except F00FL and F01CJ)
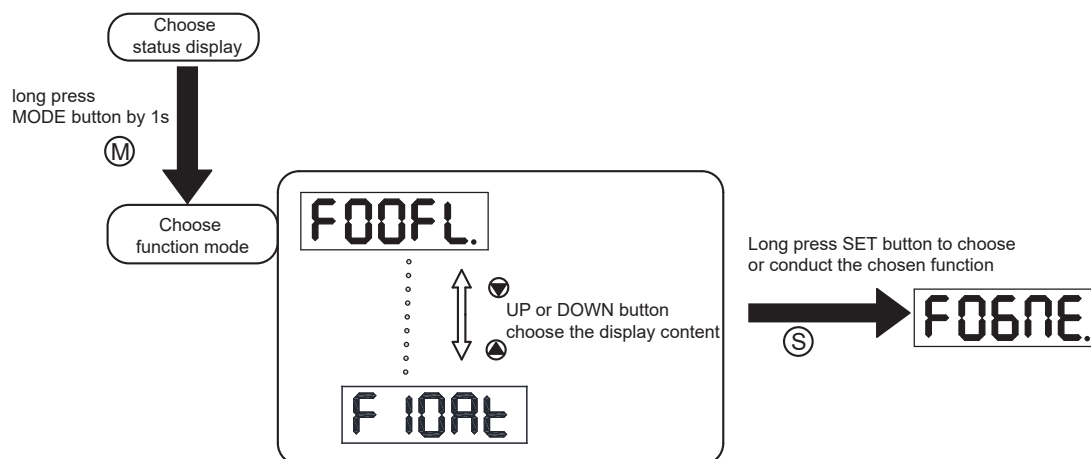
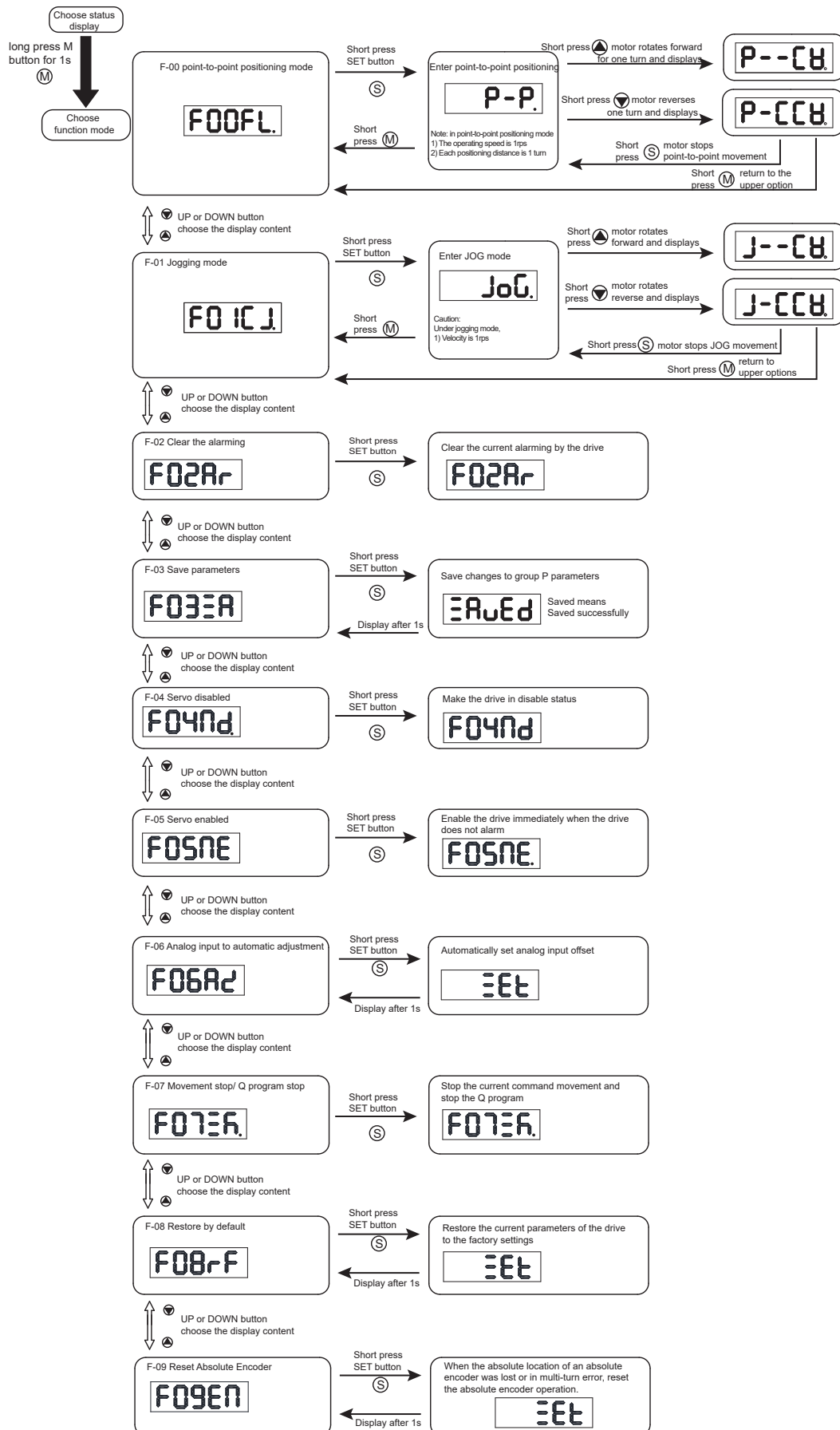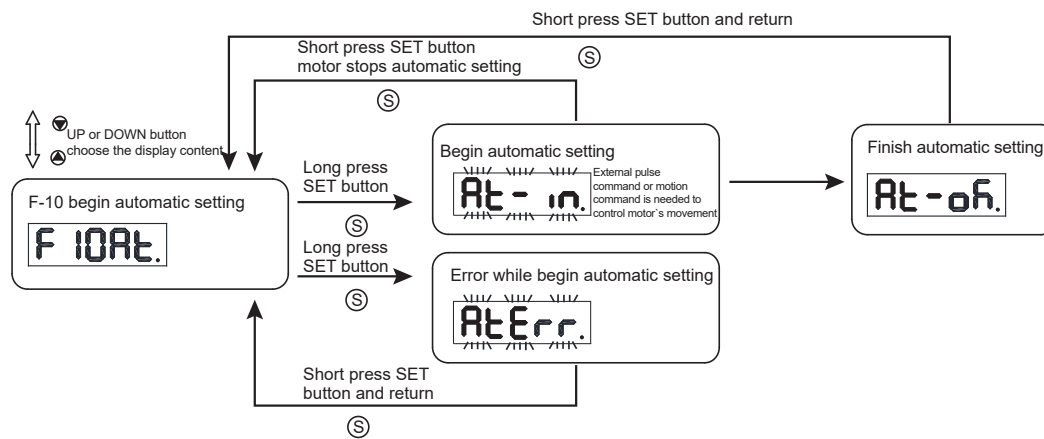### 5.5.1 Function operation mode function comparison chart

Function operation mode content is as follows:

| F-Function Operation Mode	Display Symbol	Explanation
F00	FOOFL	point to point position mode: rotating speed is1rps; travel distance is 1rev
F01	FO1CJ	JOG mode:JOG speed 1rps
F02	FO2Ar	(F02AR) ---- Clear drive's current alarm
F03	FO3SA	(F03SA) ---- Save parameter changes for P
F04	FO4Md	(F04MD) ---- Drive disable
F05	FO5ME	(F05ME) ---- Drive enable
F06	FO6Az	(F06AZ) ---- Analog auto tunning
F07	FO7SK	(F07SK) ---- Motion Stop/Q Stop
F08	FO8rF	(F08ERF) ---- Restore drive parameter to default setting value
F09	FO9EM	(F09EM) ---- Reset absolute encoder
F10	F10At	(F10AT) ---- Start automatic setting

MOONS'

5.5.2 Operation Flow Chart

Short press SET button and return

Short press SET button
motor stops automatic setting

Ⓢ

UP or DOWN button
choose the display content

F-10 begin automatic setting

F 10At.

Long press
SET button

Ⓢ

Long press
SET button

Ⓢ

Begin automatic setting

At - in.

External pulse
command or motion
command is needed to
control motor's movement

Error while begin automatic setting

AtErr.

Finish automatic setting

At - of.

Short press SET
button and return

Ⓢ

5.6 Parameter Setting Mode

5.6.1 Parameter setting method

In this mode, users can modify the parameters to be set and display them with P+ parameter number。

1) Short press M button to choose the digit needed to be set

2) Short press "UP" to make the number larger

3) Short press "DOWN" to make the number smaller
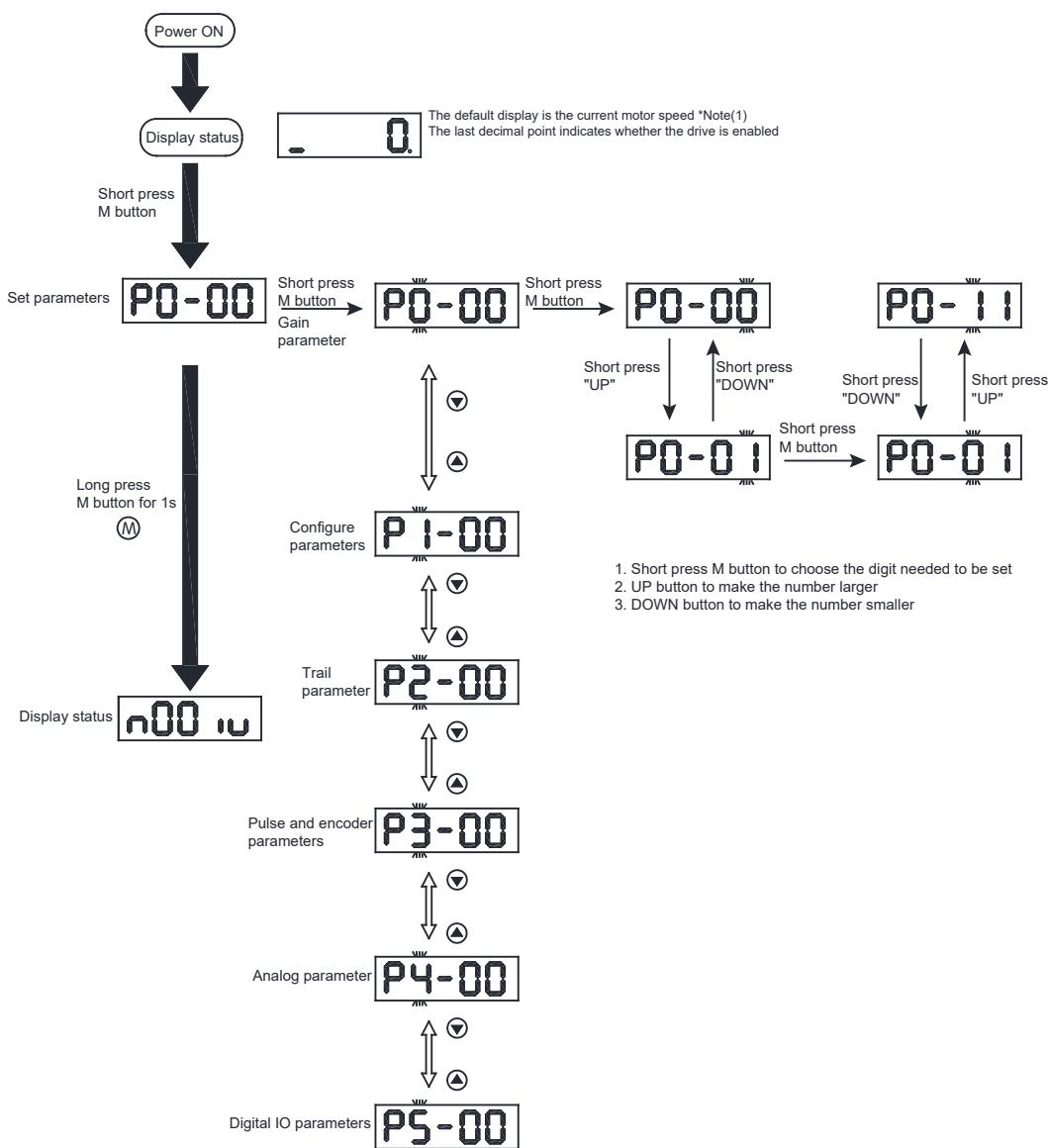
### 5.6.2 The revision and saving example of the parameters

A. Revise parameters:

1) Short press "M" button to make move to higher-digit and choose the digit needed to be set

2) Long press "M" button to make move to lower-digit and choose the digit needed to be set

3) Short press "UP" button to make the number bigger

4) Short press "DOWN" button to make the number smaller

5) Long press S button to confirm modify the parameters

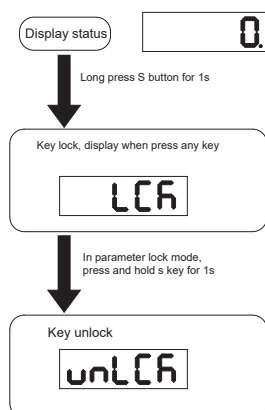Set example: modify the content parameter P0-05 to "15531"
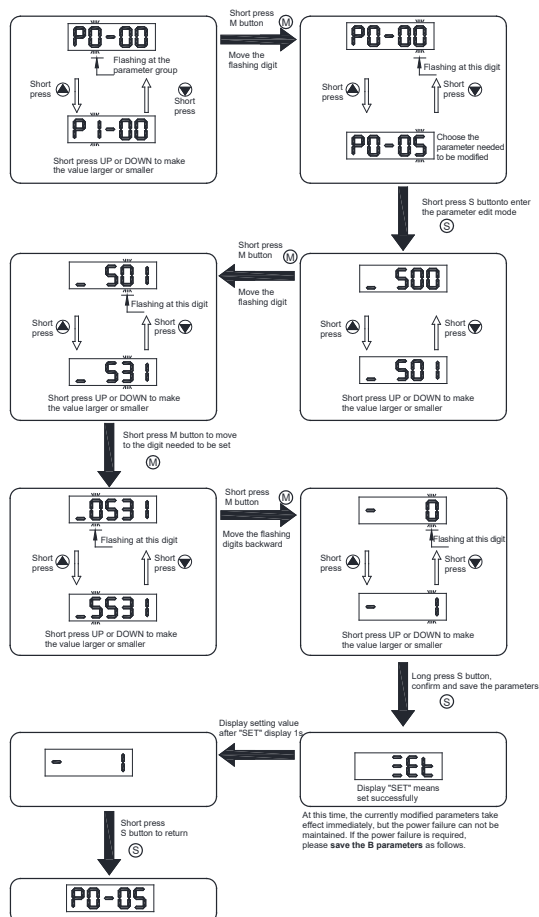
B. Save parameters

After the parameters have been modified successfully, it takes immediate effect (except for some parameters that need to be powered off to take effect). However, it will not be powered off, that is, after the next power on, it will restore to previously saved values. To maintain power-off, please do the following.
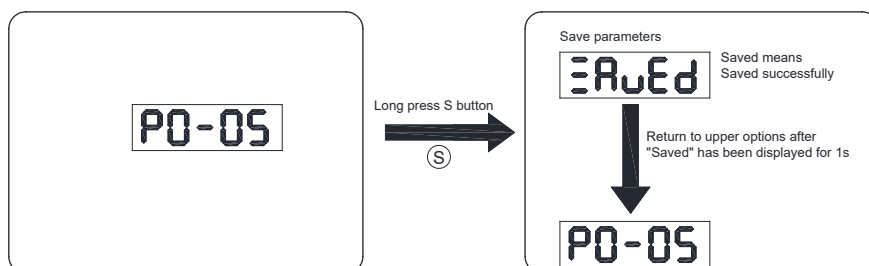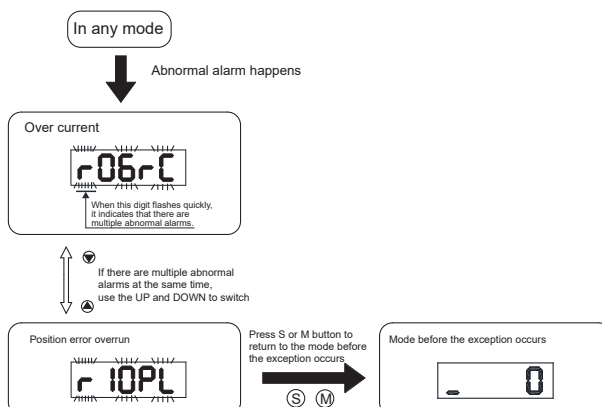
5.7 Control Panel Lock

In order to prevent misoperation by personnel unfamiliar with the drive, M3 Ether CAT series AC servo drive provides key lock function. When the button has been locked, man can not operate or modify parameters.

Display status

0.

Long press S button for 1s

Key lock, display when press any key

LCk

In parameter lock mode, press and hold s key for 1s

Key unlock

unLCk

5.8 Warning And Fault Display

In any case, once the drive generates the following alarms, it will enter the abnormal alarm display mode. If multiple abnormal alarms are generated at the same time, you can press ▲ ▼ page turning to view. Short press Ⓜ to Ⓢ return to the mode before the abnormal alarm.

In any mode

Abnormal alarm happens

Over current

r06rC

When this digit flashes quickly, it indicates that there are multiple abnormal alarms.

If there are multiple abnormal alarms at the same time, use the UP and DOWN to switch

Position error overrun

r 10PL

Press S or M button to return to the mode before the exception occurs

Ⓢ Ⓜ

Mode before the exception occurs

_ 0

Alarm display codes are as follows

LED display	Description	Alarm type	Drive status after alarm occurs
r0 1ot	Drive over temperature	Fault	Servo off
r02ur	Drive internal voltage error	Fault	Servo off
r03uH	Over voltage	Fault	Servo off
r04HC		Fault	Servo off
r05LC	Over current	Fault	Servo off
r06rC		Fault	Servo off
r09Eb	Motor encoder disconnected	Fault	Servo off
r 10PL	Position error	Fault	Servo off

LED display	Description	Alarm type	Drive status after alarm occurs
r11Lu	Low voltage	Fault	Servo off
r12ou	Velocity limited	Fault	Servo off
r13Lt	CW limit or CCW limit activated	Warning	No change to drive's status
r14cL	CW limit is activated	Warning	The motor cannot continue to reverse without changing the current state
r15JL	CCW limit is activated	Warning	The motor cannot continue to rotate forward without changing the current state
r16CL	Current foldback	Warning	No change to drive's status
r17CE	Communication error	Warning	No change to drive's status
r18EF	Parameter save failed	Warning	No change to drive's status
r19LP	Drive main circuit power input phase loss	Fault	Servo off
r20to	STO is activated	Fault	Servo off
r21rF	Regeneration failed	Warning	Servo off
r22u8	Voltage warning	Warning	No change to drive's status
r239E	Blank Q segment	Warning	No change to drive's status
r24dd	Move when the drive is disabled	Warning	No change to drive's status
r25ur	Drive internal voltage error	Fault	Servo off
r26ur		Fault	Servo off
r27E	Emergency stop	Warning	Status is determined by the setting value of 0x2038.
r28FP	Full closed-loop hibrid deviation error	Fault	Servo off
r29FE	Second encoder signal error	Fault	Servo off
r30nE	Storage error	Fault	Servo off
r31bt	Absolute encoder battery low voltage	Warning	No change to driv's status
r32AP	Absolute position los warning	Warning	No change to drive's status
r33oP	Absolute position overflow	Warning	No change to drive's status
r34nt	Motor over temperature	Fault	Servo off
r35Ct	Drive processor over temperature	Fault	Servo off
r36nr	Absolute encoder battery low voltage	Fault	Servo off
r37Et	Motor stall	Fault	Servo off
r38CE	EtherCAT Communication error	Fault	Servo off
r39Hr	Homing parameter error	Warning	No change to drive's status
r40HC	Current surge	Fault	Servo off

LED display	Description	Alarm type	Drive status after alarm occurs
r41Er	Modtor encoder communication error	Fault	Servo off
r42 io	I/O signal reuse	Warning	No change to drive's status

6 Preoperational mode

When using preoperational mode, disconnect the servo motor from any mechanical system to prevent damages and accidents. Preoperational mode should be used only under a no load condition.

6.1 Inspection Before Trial Run

To avoid any accidents and damages to the servo drive and mechanical systems, the following safety checks are recommend before the drive is turned on.

1) Connection inspections
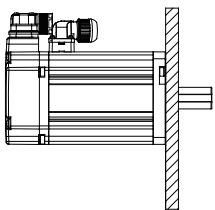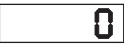
- Ensure secure wiring for power connector P1, motor connector P2, encoder connector CN3, and communication connector CN1. Check the wiring connections, and that wires are correctly insulated (to avoid short circuits) for all connectors.

- Ensure the ground wire from power connector P1, and motor connector P2 are securely connected to the shield ground.

2) Power supply inspection

- Ensure the power supply between L1/L2/L3 meets the drive's power supply specifications.
- Ensure the power supply between L1C/L2C meets the drive's power supply specifications.
- Check that the servo drive and motor are securely installed.

3) Make sure no load is connected to the servo motor.

6.2 Trial Run Procedure

| Step	Details	Description
1	Install the motor securely. 	- The motor can be installed on the machine. - Ensure no load is installed on the servo motor.
2	Make sure the wiring between the drive and motor is correct.	- The terminals on connector P2 must be connected in the order of U - Red, V - Yellow, U - Blue, FG - Yellow/Green. If the terminals are not connected to the specified wire, the drive will not be able to control the motor. - Ensure the encoder cable is connected to CN3 correctly.
3	Confirm that the drive power circuit is connected correctly	Refer to 4.3 external main circuit wiring selection to confirm whether the power input circuit is correct
4	Before using the motor with electromagnetic brake, electromagnetic braking control circuit shall be set	Refer to 4.7 connection method of motor with electromagnetic brake
5	Supply power	Do not apply more than 380VAC power supply to the servo system.
6	If there are no alarms the LED Display will read: **0** If an alarm occurs, it will display: **r09Eb**	- When the power is on, the normal display should be shown without any alarm codes and the drive is disabled. - If the display shows alarm codes such as r-09 the encoder feedback connection is incorrect. Check the encoder wiring to the servo motor to see if it is loose or incorrect. - See Section 5.8 for a list of alarm codes.
7	JOG Trial Run without load	The system is ready to run JOG trial if all the above steps are completed.

6.3 Operations of JOG Mode

Step	LED display	Description
1	F00FL	Press (M) key into the function operation mode.
2	F05ME	Scorll (▲)、(▼) key to select F05ME to enable the motor.
3	F05ME.	Press and hold (S) key for 1 second, the drive will be enabled.The last dot will light to shows the drive is enabled.
4	F01CJ	Scorll (▲)、(▼) key to select F01CJ to run JOG mode.
5	JoG.	Press (S) key into JOG mode
6	J--CW.	Press (▲) key, the motor will rotate at CW direction with the speed 1rps.
7	J-CCW.	Press (▼) key, the motor will rotate at CCW direction with the speed 1rps.
8	JoG.	Press (S) key to stop the motor
9	F01CJ	Press (M) key back to the function operation mode.
10	F04Nd	Select F04MD and then press (S) key for 1 second, the drive will be disable.

6.4 Configuration by Personal Computer

In order to ensure servo drive and motor meet your operation requirements, we strongly recommend customer to use "Luna" for following configuration setups:

1. Configure the encoder usage mode

2. Define drive's input/output function

3. Apply auto tuning function on PID parameters for optimized motor performance

Connect to Personal Computer

Please download and install Luna
from our website:
http://www.moons.com.cn
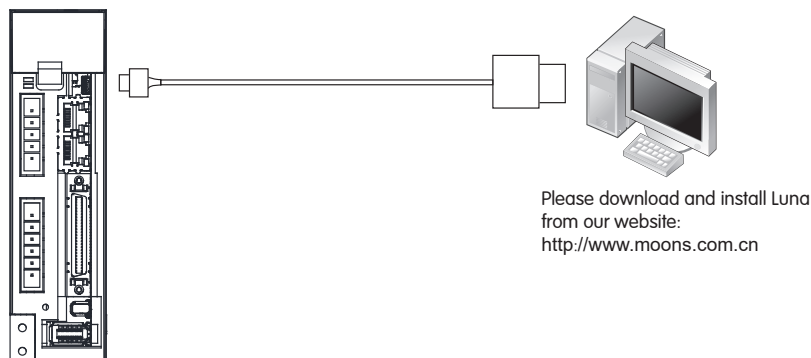
Please refer to the Luna software for detail.

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